BBC wildlife

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10 LIVING FOSSILS

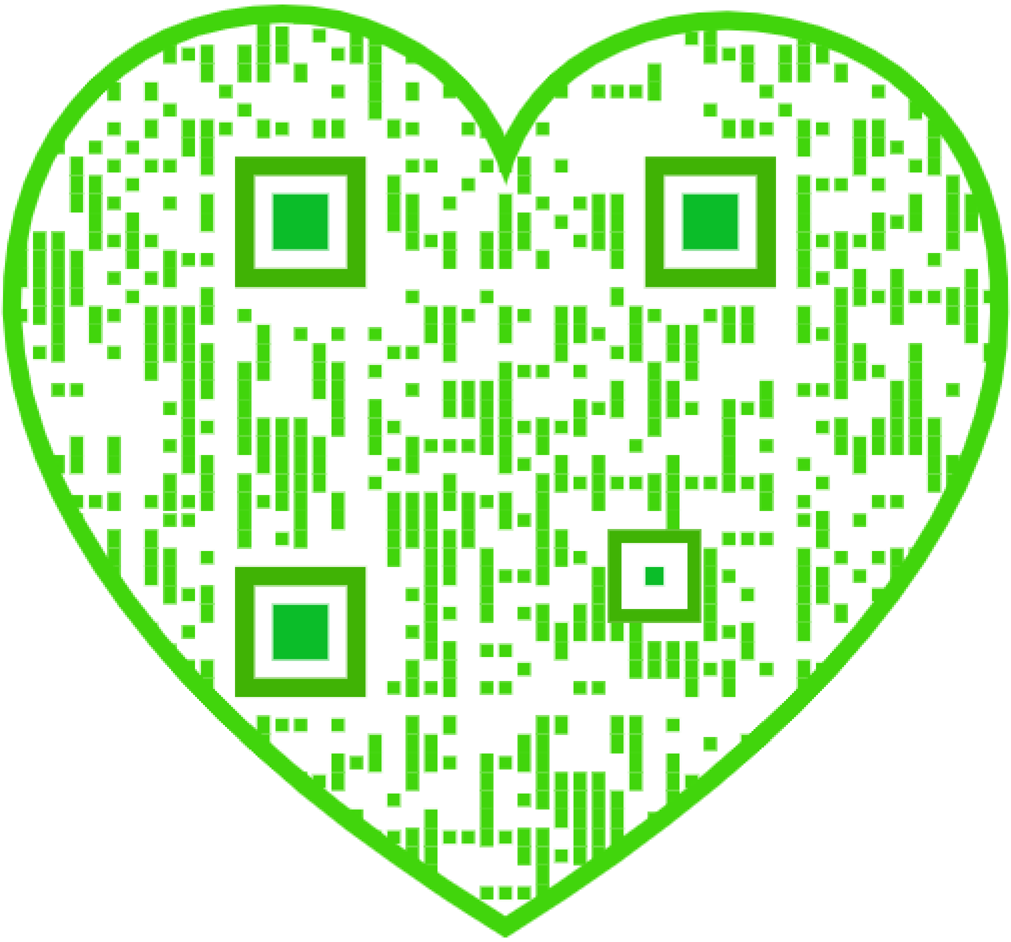
THE RESCUERS

How sea otters saved an estuary in California

Protecting Sri Lanka's whales

Sombrero lizards in the Caribbean

The race for Antarctic krill



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ON THE BBC THIS MONTH

Wild barn owl in flight

Inside Science

Every species of wild bird in the UK is continuing to decline at a stark rate. In the episode *Wild Birds in Crisis*, guest presenter Ben Garrod sees the impact for himself and finds out what is happening to tackle the problem.
Catch up on BBC Sounds

Dolphins in the Sea of Cortez

The Americas

If you missed any episodes of this epic series, catch up with them now on iPlayer. From the frozen north to tropical beaches, mountain peaks to arid plains, this breathtaking supercontinent is a place the most unexpected creatures call home.
Catch up on iPlayer

Scotcast

Who thinks lynx should roam the Highlands, asks this episode. After four lynx and a group of feral pigs were let loose, the Scottish news podcast speaks to rewilding campaigner Peter Cairns and the BBC's climate editor, Justin Rowlatt.
Catch up on BBC Sounds

BARN OWL: TMO BIRDS/ALAMY; DOLPHINS: NBC/BBC STUDIOS; SOMBRERO GROUND LIZARD: TOBY ROSS/FAUNA & FLORA

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Sombrero ground lizards live on an island off the coast of Anguilla

The rare lizard that shows how conservation offers hope

PAUL McGUINNESS, EDITOR

When I first read the story of the rare Sombrero lizard (*p66*), I couldn't help but picture a reptilian version of one of Zorro's enemies. And while I was initially disappointed to learn that this was no masked Mexican from the movies, the tale of the Sombrero lizard had me hooked. It's a great story of how conservation can make a difference and offer hope – something we could all do with an injection of from time to time.

But it's not just human conservationists we're celebrating this issue. Our cover star is an ecosystem engineer, and the story of how sea otters have restored the seagrass in a Californian estuary in just a few decades (*p52*) shows how nature can look after itself – if we only give it the chance.

Enjoy the issue!

Paul

BBC wildlife

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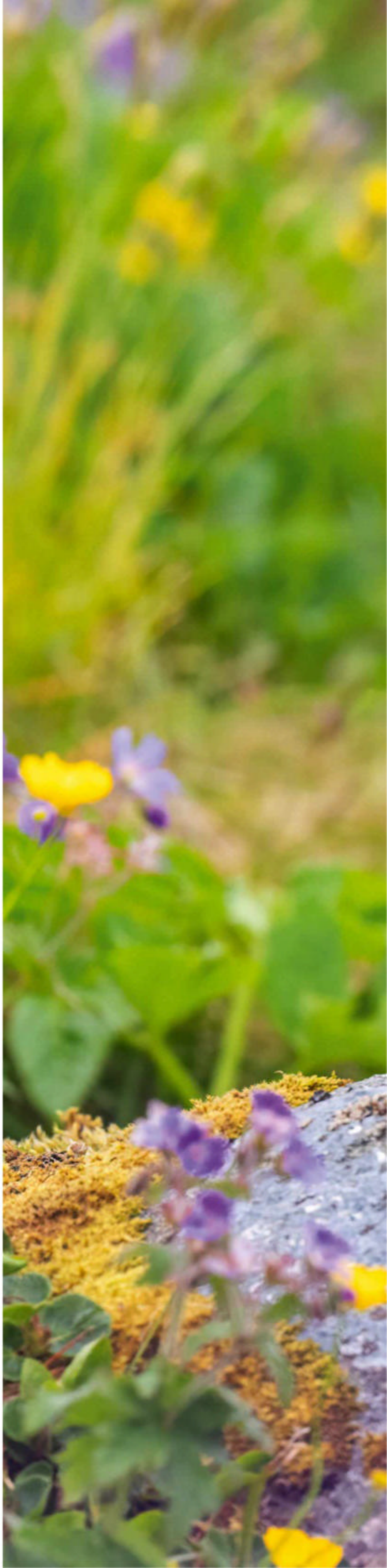

ARCTIC FOX CUBS: MARCO SCOCCO/GETTY

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May.

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MAY
10 LIVING FOSSILS
THE RESCUERS
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THE COVER

Gracing the cover this issue is this image, taken by Ralph Pace, of a female otter grooming in Monterey Bay off the coast of California, USA. Otters will often find refuge in harbours to sleep or rest during the night and early morning. *See p52*

42

Discover the wildlife of Yosemite

YOSEMITE: ROBB HIRSCH; BLUE WHALE: WATERFRAME/ALAMY; PUFFIN: DREW BUCKLEY/ALAMY; BLUE-FRONTED PARROT: BRUCE THOMSON/NATUREPL.COM

Every month, only in *BBC Wildlife*

NICK BAKER
"Any predator foolish enough to take a bite ends up with a mouthful of poison-slavered hairs" *p36*

GILLIAN BURKE
"Nature was a wild, vivid and abundant protagonist in almost every adventure and misadventure" *p27*

MARK CARWARDINE
"All sorts of wildlife is trapped, snared, shot and sometimes poisoned on grouse moors" *p30*

LUCY COOKE
"These microscopic relatives of the flatworm haven't had a sniff of sex for 80 million years" *p29*

MIKE DILGER
"If you arrive in the morning, a huge wall of jellyfish should be heading straight for you" *p32*

08 Wild Times
Catch up with all the latest developments and discoveries making the headlines

18 Special report
Huge whales depend on tiny crustaceans – but the fishing boats now want them, too

32 Mike Dilger's wildlife spectacles
On a tiny Pacific island, millions of jellyfish follow a strict schedule for sun worship

36 Nick Baker's hidden world
It looks dashing, but don't be fooled by the maned rat – its hairs are dangerously toxic

42 Yosemite's wild heart
Among the dramatic landscapes of this national park, equally remarkable wildlife thrives

52 The engineers
We knew sea otters saved kelp forests. But we didn't know they could save estuaries, too

62 My friends, the owls
In the company of owls, writer and poet Polly Atkin finds solace from debilitating illness

66 Love for a lizard
A tiny island has made a remarkable ecological recovery, helping to save a rare lizard

72 Sea of giants
An unusual alliance is forming to save the remarkable whales that live around Sri Lanka

72

The alliance to protect whales from ships

DON'T MISS...

In May, new pufflings arrive – each waiting for deliveries of silvery sandeels *p22*

Discover MORE

Blue-fronted parrot in Brazil

80 Q&A
How did pigs get to Pig Island? And which country has the most species?

86 Species guide
Leafy seadragons, the bony, camouflaged fish that hide in plain sight

88 Photo Club
Including Snap Chat

93 Crossword
Plus Spot the Difference

94 Your Letters
Join the debate

98 10 living fossils
Meet the amazing survivors from the dawn of time

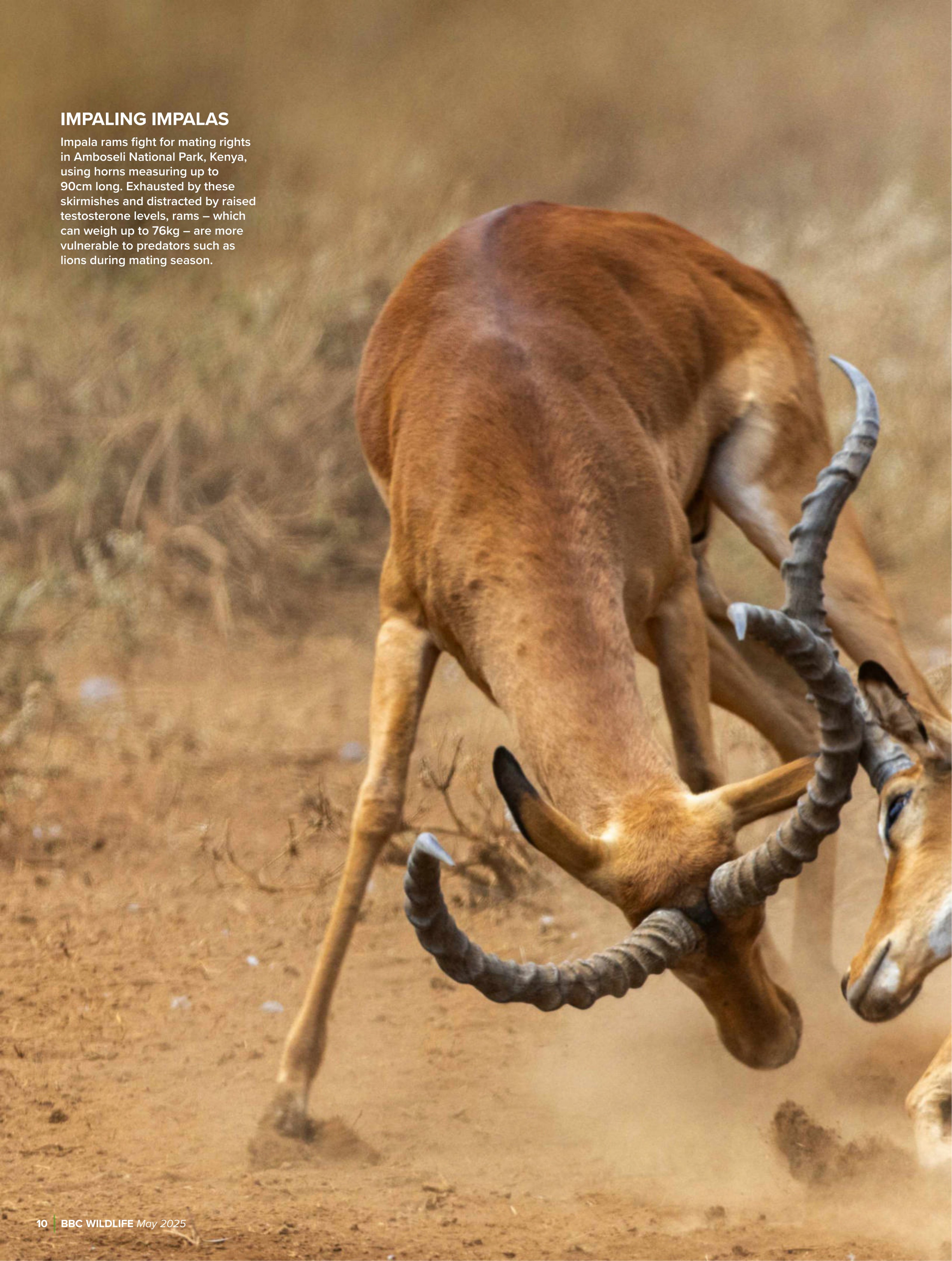
wild TIMES

The latest news, photography and seasonal wildlife highlights

GOLDEN WONDER

Seen here on a branch in a cloudforest in Ecuador, golden tanagers are found in Andean foothills and subtropical regions across an arc in South America that spans Bolivia to Venezuela. As the name suggests, they are mostly a bright golden yellow, with black streaks on their backs and black ear patches.

GOLDEN TANAGER: ANDY ROUSE/NATUREPL.COM



IMPALING IMPALAS

Impala rams fight for mating rights in Amboseli National Park, Kenya, using horns measuring up to 90cm long. Exhausted by these skirmishes and distracted by raised testosterone levels, rams – which can weigh up to 76kg – are more vulnerable to predators such as lions during mating season.

IMPALAS: DENIS-HUOT/NATUREPL.COM

Wild boar threaten Chile's rare monkey puzzle forests

Invasive pigs binge on seeds of endangered 'living fossils'

A NEW STUDY WARNS THAT A RARE FOREST ecosystem in South America may be under threat – from a voracious wild pig species imported from Europe. Native to the slopes of the Andes Mountains in Chile and Argentina, the monkey puzzle tree (*Araucaria araucana*) has sometimes been called a 'living fossil' because of its resemblance to fossils from the Late Triassic period, more than 200m years ago. After years of illegal logging, the tree was declared Endangered in 2013.

Now wild boar, originally shipped from Germany around 1950 and released as prey for hunters, may pose a growing threat, according to the authors of a study published in *PeerJ Life and Environment*. Wild boar can cause major damage to delicate ecosystems because their foraging habits frequently disrupt the growth of native plantlife.

By deploying camera traps in the monkey puzzle forests of Villarrica National Park in Chile, researchers were able to make the first ever density estimate for wild boar in South American temperate forests. The results showed about 1.4 individuals per km^2 – lower than in the species' native range. But even small numbers of boar may cause long-lasting effects, the researchers say.

In the case of monkey puzzle forests, the boar disrupt the seedlings, which take up to 40 years to reach reproductive age. "Wild boar feed on the seeds, impacting the regeneration of this forest in a way that we do not yet fully understand," says the study's co-author Oliver Keuling, senior researcher at the University of Veterinary Medicine in Hannover, Germany.

There are few controls on the boars. While pumas do feed on them, human interventions such as trapping are in the early stages. The authors say that more monitoring is necessary to ascertain the long-term effects of their activity. **Richard Pallardy**

LANDSCAPE: BLICKWINKEL/ALAMY; WILD BOAR: DE MEESTER JOHAN/ ARTERRA PICTURE LIBRARY/ALAMY

Monkey puzzle forests offer wild boar little else to feed on – except their seeds, say researchers

The king eider is one of 112 'tipping point' birds identified in the report – species that have lost more than 50 per cent of their populations within the past 50 years

America's birds in peril

Steep declines of widespread birds is causing concern

OVERALL, NORTH AMERICAN BIRD populations have plummeted by 30 per cent since the 1970s, mirroring a similar trend in the UK, according to the 2025 US State of the Birds report.

The trend among common and abundant birds is a particular worry to scientists, such as Amanda Rodewold at the University of Cornell's Lab of Ornithology. "We are talking about species that should be able to live alongside us," says Rodewald. "This should wake us up, because we know from the loss of the passenger pigeon how an abundant species can reach a tipping point."

Grassland birds have been particularly badly hit, with populations decreasing by 43 per cent in the past half century. In the American Midwest, there are an estimated 130 million ha of grassland, but these are being lost at a rate of 400,000-800,000ha a year. Birds showing the steepest declines include the mountain plover and Baird's sparrow.

Wildfowl such as ducks have largely recovered since the 1970s, but numbers have dropped again in the past decade. Again, even common species such as the mallard and northern pintail are not immune to these downward trends.

Rodewald cites various factors for the declines. "Agricultural intensification and the conversion of grassland to crops is a major cause," she says. Intensification can be anything from greater use of pesticides to loss of hedgerows. Climate change is another issue, leading to droughts that have hit species in North America's so-called 'aridlands' – biomes such as the Mojave and Sonoran Deserts and their shrub-steppe habitat.

The report argues that the annual economic output generated by activities related to birds and birding is estimated at $280 billion (£220 billion), making the case for increased federal and state expenditure on wildlife conservation. **James Fair**

The film shows how to restore the health of the world's seas

Sir David narrates new cinema film

A POWERFUL NEW FILM SHOWCASING our blue planet, *Ocean With David Attenborough*, is being released on 8th May in cinemas worldwide to coincide with the broadcaster's 99th birthday.

Immersive cinematography transports us beneath the surface to explore the wonders of coral reefs, kelp forests and the open ocean, and reveals how healthy oceans are key to a stable and flourishing planet.

"My lifetime has coincided with the great age of ocean discovery," says Sir David. "Over the last 100 years, scientists and explorers have revealed remarkable new species, epic migrations and dazzling, complex ecosystems beyond anything I could have imagined as a young man."

While the film exposes the challenges facing our oceans – from destructive fishing techniques to coral bleaching – it also brings inspiring stories from across the world of how our seas can be saved. "This could be the moment of change," says Sir David. "Nearly every country on Earth has just agreed, on paper, to protect a third of the ocean. Together, we now face the challenge of making it happen."

Produced by Silverback Films and Open Planet Studios, *Ocean* will also be available globally on National Geographic, Disney+ and Hulu later this year. **Sophie Ellis**

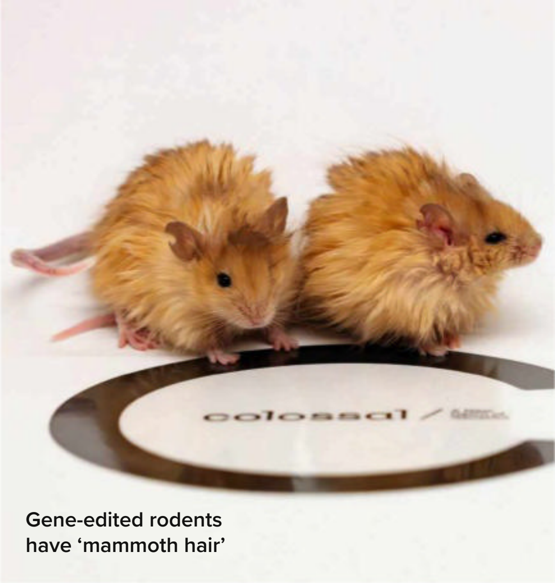
KING EIDER: EJ PEIKER/BTA/MINDEN/NATUREPL.COM; OCEANS WITH DAVID ATTENBOROUGH: DOUG ANDERSON/SILVERBACK FILMS/OPEN PLANET STUDIOS

wild TIMES

The Sundaic rhino has short teeth adapted for browsing leaves, whereas the Indian rhino has long teeth for grazing grasses

NEW NAME FOR A RARE RHINO

Scientists are calling for the reclassification of the Critically Endangered Sundaic (or Javan) rhino. The proposal follows research revealing differences in body structure and ecology that set it apart from the closely related Indian rhino. Researchers say that recognising the Sundaic as a separate genus, renaming it from *Rhinoceros sondaicus to Eurhinoceros sondaicus,* will help to tailor a suitable conservation strategy.



Gene-edited rodents have ‘mammoth hair’

Boffins breed ‘mammoth mouse’

Progress made in quest to bring back Ice Age giant

A pair of mice with luxuriant golden fur may not look like the first step in the resurrection of the woolly mammoth. But Colossal Biosciences, the company that created them through gene editing, says they demonstrate it can engineer “mammoth-like traits” into mice, producing healthy animals.

Colossal hopes to bring mammoths back to life by engineering mammoth-like traits into Asian elephants. But the firm accepts this will be more complicated than its experiment with mice. No one has ever successfully carried out IVF with an elephant, which it will have to do. Even so, Colossal insists it is on track to produce ‘mammoth’ embryos by 2026.

There were three key reasons for developing the gene-editing technology required to recreate mammoths, according to Colossal’s chief science officer Beth Shapiro. First, the giant herbivores would enhance Arctic ecosystems by performing functions such as soil fertilisation, seed dispersal and soil aeration, all of which would improve biodiversity and habitat resilience.

Second, the new gene-editing techniques can be used for other things – for example, they may one day be able to give rare Hawaiian birds immunity to non-native avian malaria. And finally, there is the “wonder, excitement and inspiration”, says Shapiro.

Some scientists are sceptical we’ll ever see a ‘functional woolly mammoth’ but, by late 2026, we should have a better idea whether these Ice Age giants will once more walk the Earth. **James Fair**

SUNDAIC RHINOCEROS: TOBIAS NOWLAN/GETTY; WOOLLY MOUSE: JOHN DAVIDSON

A deadly race for krill

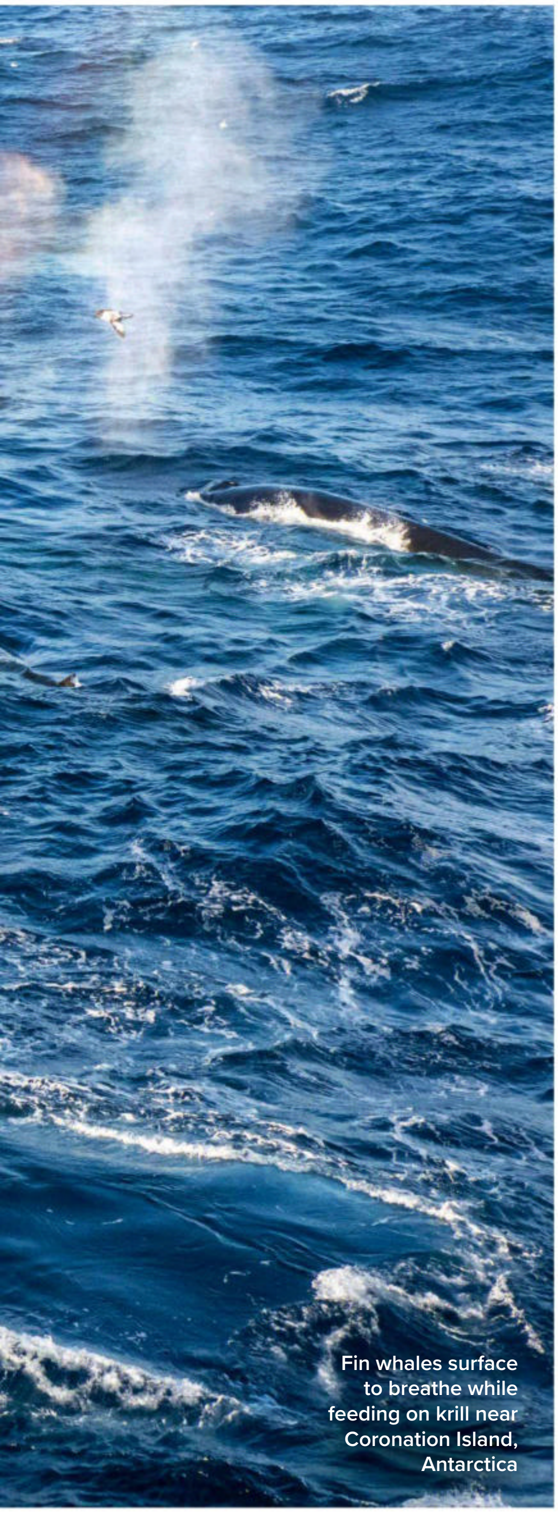
Huge whales depend on tiny crustaceans – but the fishing boats now want them, too

> **“Other predators – humans, aboard a fleet of fishing boats – are also hoovering up the crustaceans”**

It’s January 2022 and a cruise ship off Coronation Island – halfway between South Georgia and the tip of the Antarctic Peninsula – finds itself among a ‘superpod’ of about 1,000 fin whales. Beaming expedition guide Conor Ryan describes how you can smell the breath of these whales, the second-largest animals on the planet. “It smells like rotten broccoli but it’s wonderful,” he says.

Incredible footage from the encounter shows exhalations from the whales’ spouts firing into the air like hundreds of vertical cannons and thousands of seabirds swooping over the maelstrom.

The whales are feeding on a vast patch of Antarctic krill, a 6cm-long, shrimp-like crustacean said to be the most abundant wild organism on the planet, with an estimated biomass of 300-500m tonnes. It is the basis of almost the entire south polar food chain, and is predated upon by everything from fish and penguins to leopard seals and fin, blue and humpback whales.



Fin whales surface to breathe while feeding on krill near Coronation Island, Antarctica

Concerns are growing around the sustainability of krill fishing

> **“If whales don’t feed properly while in Antarctica, females have insufficient resources to breed”**

But there’s a darker side to this remarkable event. Other predators – humans, aboard a fleet of fishing boats – are also hoovering up the tiny crustaceans. These vessels harvest roughly 500,000 tonnes of krill every year to turn into farmed fish feed, health supplements and pet food.

For Matthew Savoca, a research associate at Stanford University, the story immediately planted a number of red flags. “It raised serious concerns about whether existing environmental policies for krill fishing are sufficient to ensure the long-term health of whales,” he says.

Those concerns are multiple – the most obvious being direct mortality of whales as a result of entanglement with fishing gear, and there have indeed been seven recorded deaths (of humpback whales) in the past four years. But that, though tragic, is not a conservation threat, argues Savoca.

He and other scientists are wondering if there are other, more pervasive, impacts of krill fishing. While the boats are only taking a tiny percentage of the estimated overall stock, they are doing it in a relatively tiny portion of Antarctica, which is also where many whales are known to feed.

“Competition, disturbance or just increasing stress levels that could depress reproductive output may all be having an impact,” says Savoca.

Ari Friedlaender, professor of ocean sciences at the University of California, Santa Cruz, agrees. He has carried out two decades of research in Antarctica and has demonstrated that the reproduction of humpback whales is negatively affected when the quantity of krill goes down. If whales don’t feed properly while in Antarctica, he says, females have insufficient resources to become pregnant and gestate a calf when they return to their breeding grounds.

The problem is that whales and krill boats are competing for the same resource at the same time and in the same place. “About 80 per cent of the total catch is taken from sub-areas in the Gerlache and Bransfield Strait areas. That tends to be from March to June and the location overlaps almost completely with where whales are feeding at that time of year,” he says.

Simeon Hill, an ecologist at the British Antarctic Survey (BAS), points out that krill fishing was previously divided up into different management zones but that agreement, which was implemented by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) – a treaty of 27 nations that was set up in 1982 in response to increasing commercial interest in krill – ended last year.

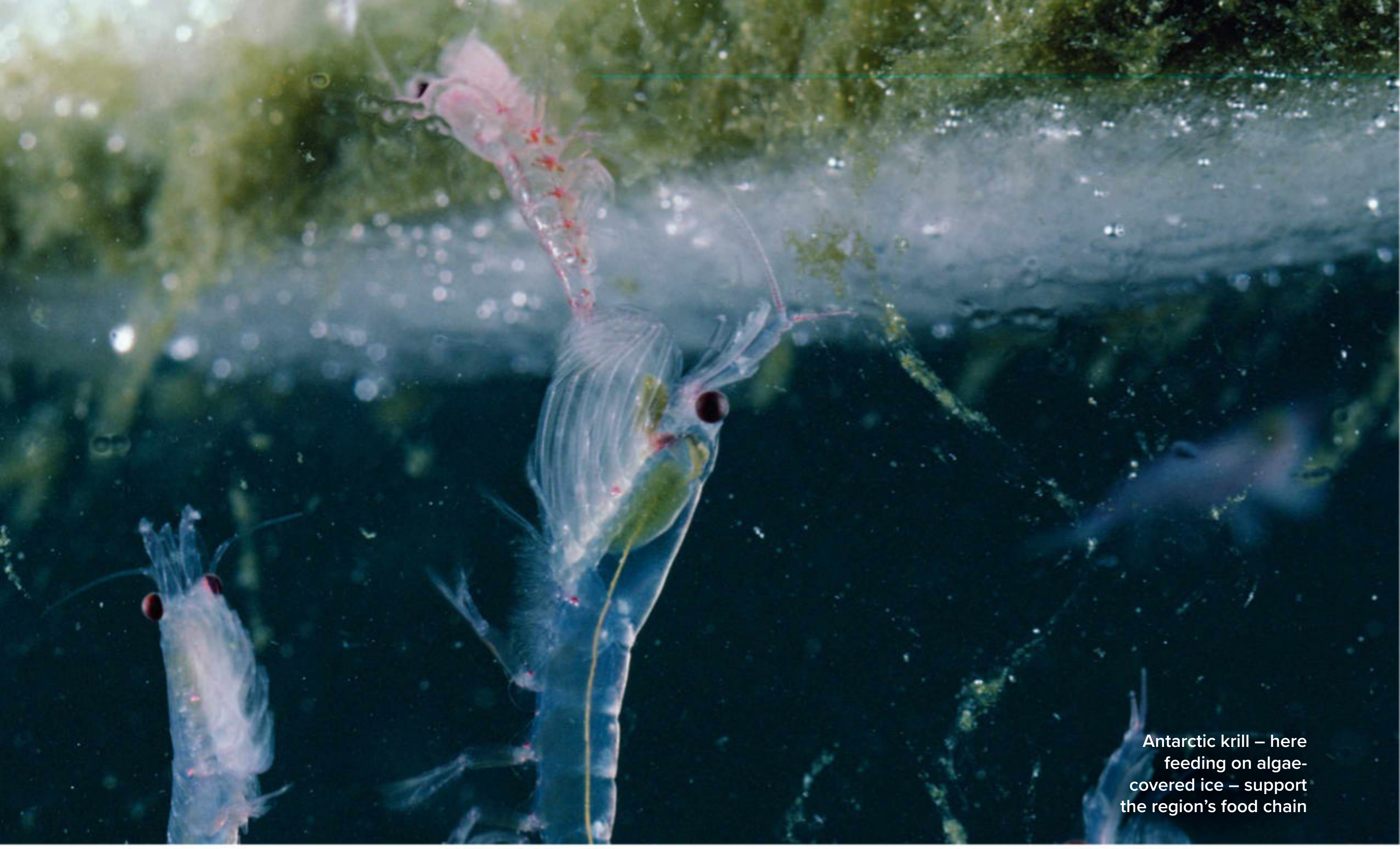
This year, the krill fleet has been able to take krill up to the so-called 620,000 tonne ‘trigger limit’ (it’s not technically a quota, though it acts like one at present) from any part of the broader sea area. “It is regressive,” Hill says. “There is less potential for regulating environmental impacts.”

The wider issue is whether krill-harvesting companies are gearing up to increase how much they catch. While there have been some moves over the years to market krill for direct human consumption, this has never taken off.

But Javier Arata, executive director of the Association of Responsible Krill Harvesting Companies (ARK), points out that there are a lot of fish farms in the world that need to find sources of protein from somewhere.

“The pelagic stocks of species such as anchovies are already over-exploited,” he says. “A few years ago, there was a crash in the Peruvian [anchovy] fishery, so boats went to Africa and are over-exploiting the one down there. Krill fishing can help to

FIN WHALES: ROBERT HARDING/ALAMY; ANTARCTIC KRILL TRAWLER: FLIP NICKLIN/NATUREPL.COM



Antarctic krill – here feeding on algae-covered ice – support the region's food chain

ANTARCTIC KRILL: FLIP NICKLIN/NATUREPL.COM

> **"Krill are cold-water creatures. As sea temperatures rise, they will be forced south until they run out of road"**

reduce the pressure on other stocks used in fish farming."

Nevertheless, Arata doesn't believe there is any great demand from krill companies to massively raise how much they catch, partly because it's not clear if and when CCAMLR would up the trigger limit. "We're waiting for a political decision, everything has to be agreed by consensus," he says. If just one CCAMLR nation disagrees with a proposed measure, it doesn't pass.

But in any case, he argues, ARK members are keen to avoid negative impacts on whales. They are currently voluntarily investigating (using underwater cameras) why whales are interacting with fishing gear and whether more effective solutions can be found to stop them.

Matthew Savoca says it's vital to understand whether localised krill fishing is impacting Antarctic predators such as whales – but there's a lot of information scientists still need. They do know that (depending on the species) a whale can consume roughly 2-6 tonnes of krill a day, while a trawler can amass an astonishing 250-800 tonnes in the same time.

What Savoca would like to do is observe fishing boats over a patch of krill (these patches, remember, are three-dimensional and can extend for many kilometres in every direction) and try to work out what percentage of that krill they are taking. "We might be able to say with some confidence that they are depleting 20, 40 or 60 per cent of the patch, and that would displace a certain number of whales for a certain number of days."

Because the scientists know the energy requirements of the whales, and what they need to migrate and have a calf, they could then theoretically calculate the impact of the krill fishery.

PAN OUT A LITTLE FURTHER AND THERE is an even darker cloud on the horizon: climate change. Antarctic krill are a cold-water species and, as sea temperatures rise, they will be forced further and further south until they eventually run out of road.

Friedlaender says climate change is the "press" and krill fishing the "pulse". "Climate change is a global threat, so there's no single way to stop it. The pulse is the krill fishery, and it proportionately has a smaller impact than climate change, but it's the thing we can manage and control."

Like Savoca, Friedlaender says there will always be a need for more data, though he can't even get his science on the table with CCAMLR because it wasn't set up to consider whale conservation.

Still, he's undeterred. "There's no way that more science and more truth is a bad thing," he says. "But we need to communicate it as broadly as possible."

Simeon Hill adds that there is another, arguably even more critical reason to be worried about krill. The crustaceans sequester at least 39m tonnes of carbon (in their faeces and shells) in the depths of the Southern Ocean every year, roughly equivalent to 40 per cent of the UK's entire emissions output.

Many of the baleen (or 'great') whales have made spectacular recoveries since commercial whaling officially ended in the 1980s. Humpbacks may even have rebounded to their pre-whaling numbers, though larger species such as fins and blues are still at 10 per cent or less. If Antarctica is managed properly for its wildlife, then events such as the fin whale superpod of 2022 could be just the first of many for lucky visitors to the region. The question is whether that future should also include krill harvesting – and, for the moment, the jury's out.

ABOUT THE AUTHOR

James Fair is a wildlife journalist with a specialism in conservation and controversial issues. Read more at jamesfairwildlife.co.uk.

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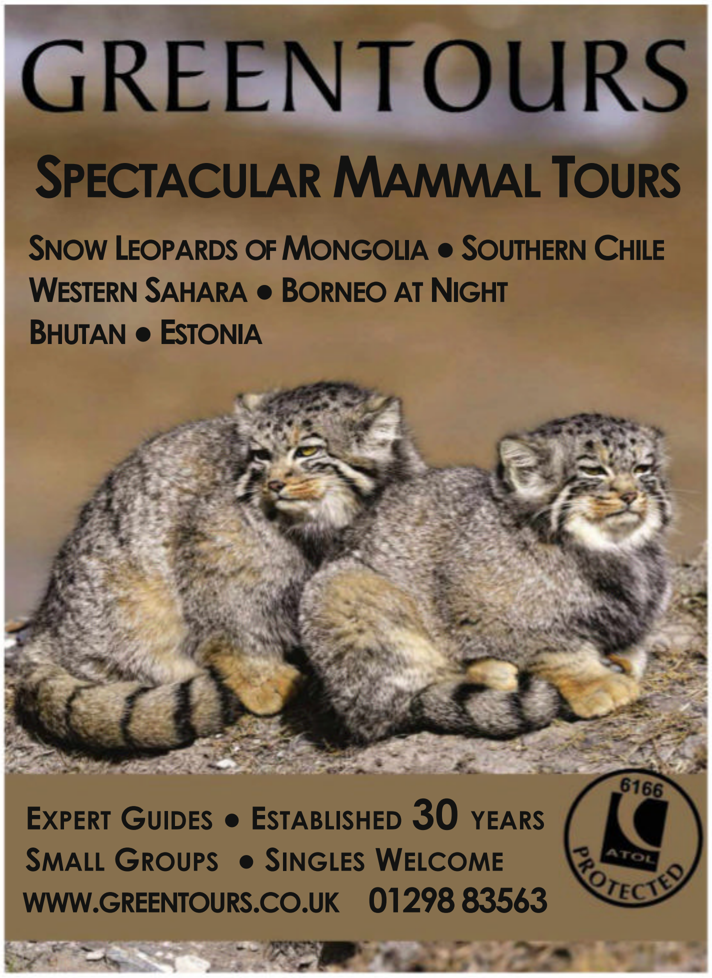
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wild MAY

7 nature encounters for the month ahead

WITH NATURALIST AND AUTHOR BEN HOARE

1

Puffins prefer to feed their chicks sandeels, which are protein-rich and easy to ingest

Puffin watch

IN MAY, A NEW GENERATION OF puffins arrives – one puffling per pair. But you won't see these fluffballs, because they stay hidden in their parents' clifftop burrows, waiting for deliveries of silvery sandeels. The ban on sandeel fishing in Scottish waters and the English North Sea, enacted in 2024 after years of campaigning, should help these much-loved seabirds, whose UK population has declined dramatically over the past few years.

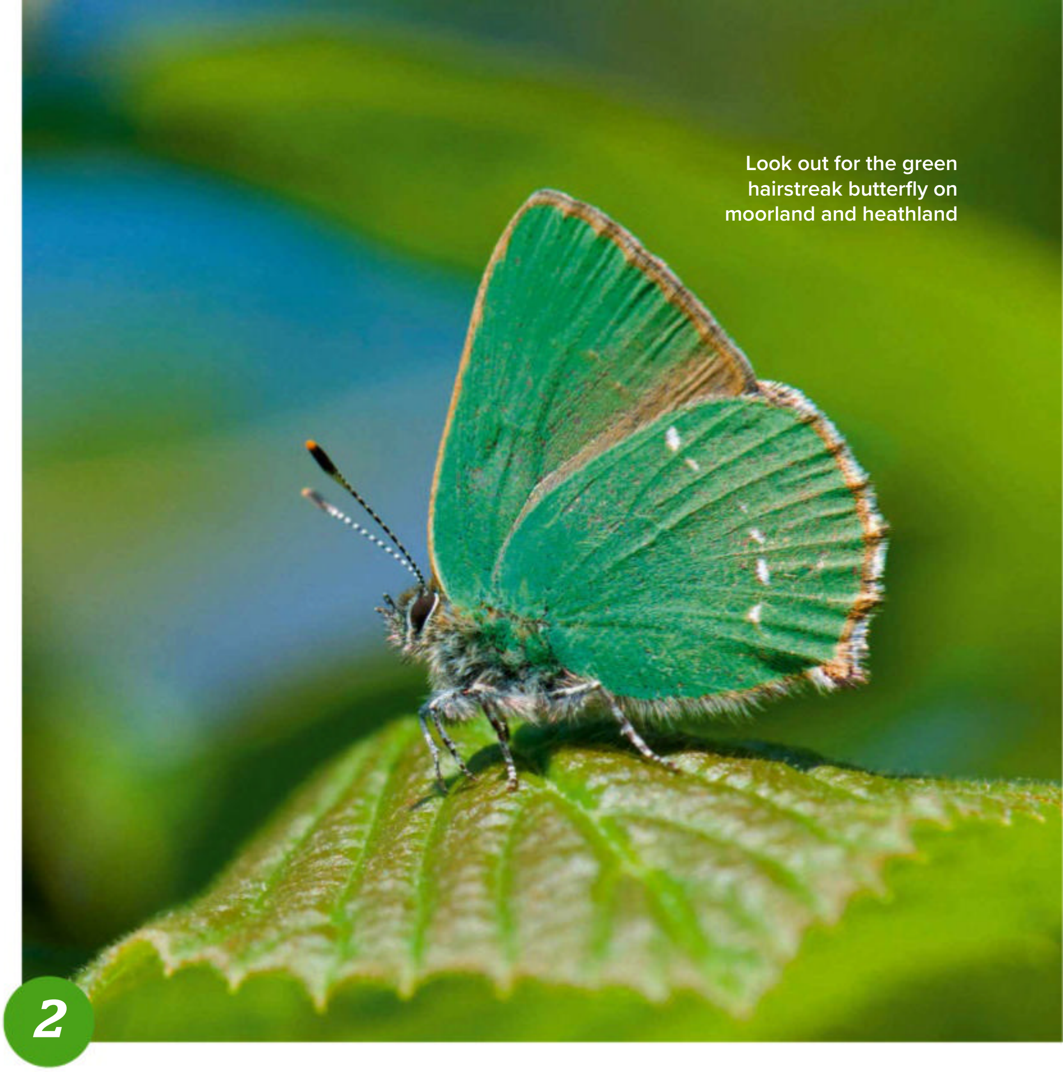
2

Spring green

GREEN BUTTERFLIES ARE FAIRLY unusual, for reasons that are not entirely clear. There are theories but, in truth, we don't really know. While there are some green butterflies in the tropics, such as Asia's spectacular birdwings, in the British Isles there's just a single species – the green hairstreak. Only the underwings are green, which sparkle like emeralds. Their upperwings are dull brown.

These little butterflies fly fast, with a kind of skittish energy. When they do land they can be surprisingly hard to spot, as they perch with wings closed, showing the green undersides that blend in with the insects' preferred heathy and scrubby habitats. Look for them sunning themselves on heather, gorse or birch trees, from April until June.

Like other hairstreak butterflies, this species overwinters as chrysalises in ant nests. The chrysalises produce sweet 'honeydew' from special glands, which the ants can't resist, so carry them away. Safe underground inside the nests, the chrysalises make curious squeaks, perhaps to placate the ant colony further while they develop.



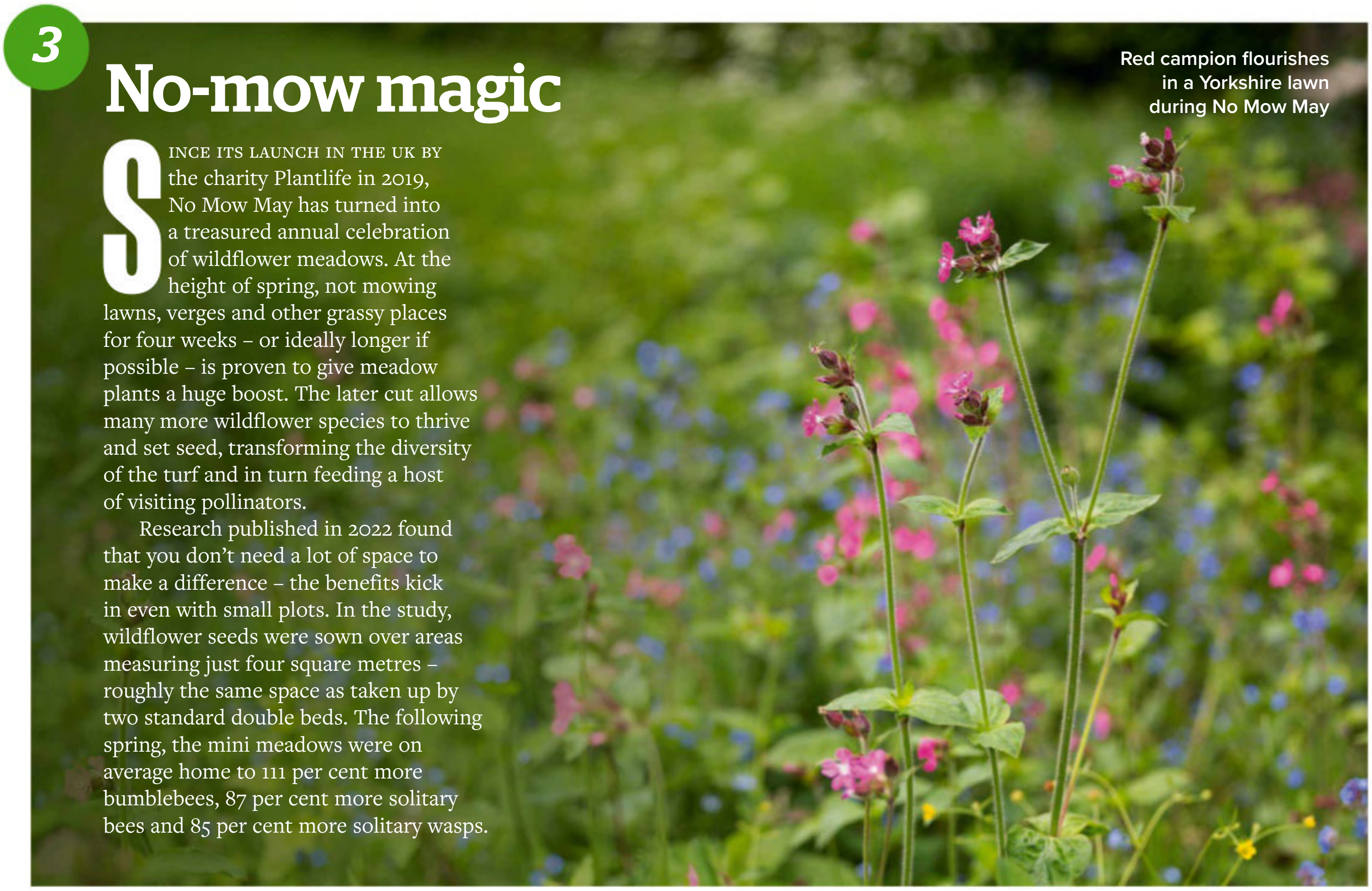
Look out for the green hairstreak butterfly on moorland and heathland

3

No-mow magic

SINCE ITS LAUNCH IN THE UK BY the charity Plantlife in 2019, No Mow May has turned into a treasured annual celebration of wildflower meadows. At the height of spring, not mowing lawns, verges and other grassy places for four weeks – or ideally longer if possible – is proven to give meadow plants a huge boost. The later cut allows many more wildflower species to thrive and set seed, transforming the diversity of the turf and in turn feeding a host of visiting pollinators.

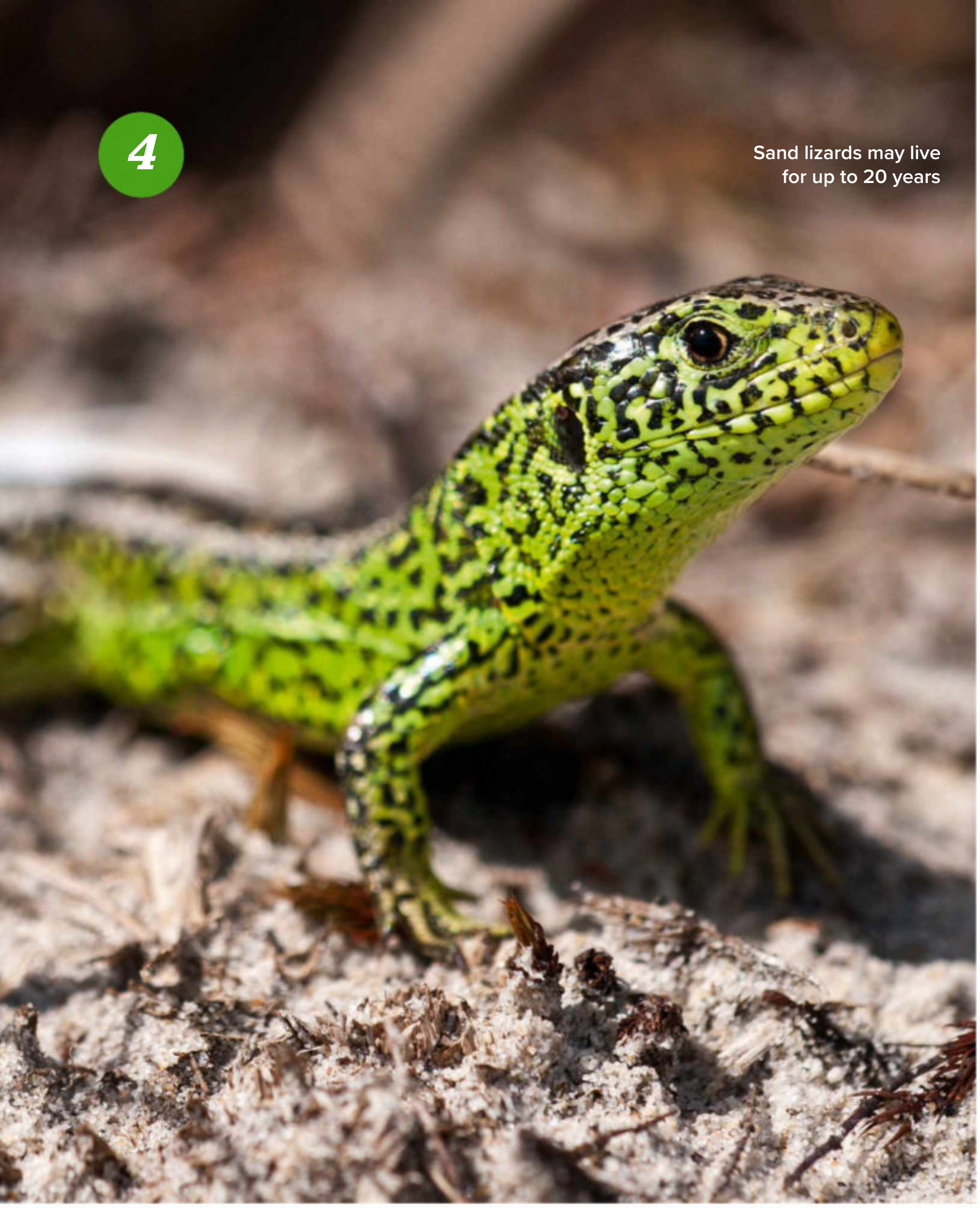
Research published in 2022 found that you don't need a lot of space to make a difference – the benefits kick in even with small plots. In the study, wildflower seeds were sown over areas measuring just four square metres – roughly the same space as taken up by two standard double beds. The following spring, the mini meadows were on average home to 111 per cent more bumblebees, 87 per cent more solitary bees and 85 per cent more solitary wasps.



Red campion flourishes in a Yorkshire lawn during No Mow May

PUFFIN: DREW BUCKLEY/ALAMY; BUTTERFLY: STEPHEN KILL/ALAMY; MEADOW: HELEN ARGO/ALAMY

4

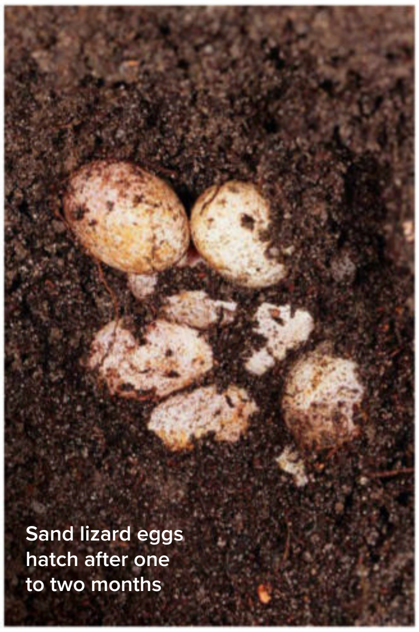


Sand lizards may live for up to 20 years

Rare sight in the sand

Britain’s most colourful native reptile by far, the sand lizard, breeds during May. The male (*above*) develops brilliant greenish-yellow flanks and takes up positions on south-facing sandy banks or slopes, basking for hours at a time as it waits for females. Surveys show that individual males can be incredibly faithful to their favoured lookouts. After mating, the females lay their eggs in an exposed position in the sand, where the sun will help incubate them.

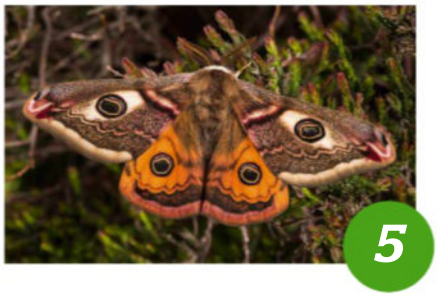
Today a rare sight in Britain, sand lizards are confined to a handful of well-managed heathlands and coastal sand dunes in the south and west of England and Wales.



Sand lizard eggs hatch after one to two months

ABOUT THE AUTHOR

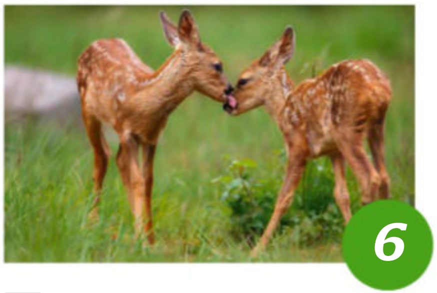
Ben Hoare is a wildlife writer, editor and all-round nature nerd. He also writes highly acclaimed illustrated natural history books for children.



5

Scenting love

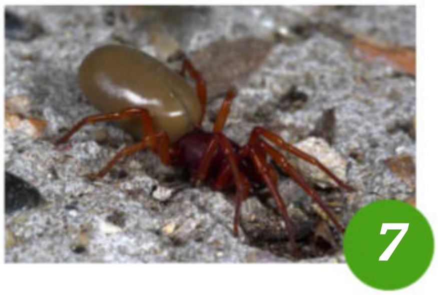
One of our most stunning moths is on the wing in May. The male emperor (*above*) is a big, fluffy creature with four huge eye-spots and flies during the day, using feathery antennae to track down the scent of resting females up to several kilometres away.



6

Fawn season

Roe deer give birth, usually to twins, in May and June. The mums-to-be retreat to the security of bracken or bramble thickets and their fawns have white-spotted coats for extra camouflage. However, as with all deer in Britain, humans are now their sole predators.



7

Louse hunter

The warmer temperatures of spring and summer bring out the woodlouse spider, which as its name implies hunts woodlice, often in gardens and around buildings. It is equipped with extremely strong jaws to pierce the tough exoskeleton of its prey.

SAND LIZARD: ROSS HODDINOTT/NATUREPL.COM; EGGS: TONY PHELPS/NATUREPL.COM; EMPEROR MOTH: ALEX HYDE/NATUREPL.COM; ROE DEER: ALEX WITT/ALAMY; WOODLOUSE SPIDER: ROBERT PICKETT/NATUREPL.COM

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The dawn chorus is a bittersweet symphony for Gillian

OPINION

GILLIAN BURKE

“Nature was a vivid and abundant protagonist in Dad’s stories”

“THE DAWN CHORUS IS ALWAYS one of the big highlights in the nature calendar, especially in temperate zones where early morning birdsong not only marks the start of a new day but tells us that summer is just around the corner. At this time of year, the shortening nights have every bleary-eyed dawn chorus enthusiast getting up earlier and earlier to soak in a sound bath of birdsong. Every one that is, except me.

In recent years, the dawn chorus has taken on the tone of a bittersweet symphony, as a reminder of waking up each morning in an uncomfortable hospital chair by my father’s bedside. This is where I would sleep, during his last days, determined that he should not be alone when he eventually passed on.

On the tropical East African Swahili coast, where my father was born and eventually died, the dawn chorus is a steady, year-round performance that sounds more like a daily changing of the guard than a seasonal awakening. The nocturnal noises of chirping crickets, singing frogs and shrieking bushbabies give way, at the first hint of light, to a layering of different bird calls and song that build to a brilliant, riotous wall of sound.

From inside the ward, I would pick out acoustic details: the metronomic tinkerbird setting the tempo, as a bushshrike joined in with its lyrical fluty calls. The percussive beats of a chatty brownbul would cut across the rhythm as the equatorial sun finally burst on to the scene, putting an abrupt end to the whole piece as it made its hasty ascent into the morning sky. Only a lone male goshawk would be left, out of sight from my dad’s bedside but, judging by the sound of it, no doubt circling and calling out through his insistent territorial display.

Tuning into these details helped connect me to the world outside but it was also a chance to really listen to my dad. At 88 years old he was very hard of hearing, so I found it easier to let him do the talking. He was interesting and entertaining – his body may have been failing him but he hadn’t lost his sense of humour and his mind remained sharp.

I am struck by the stories he chose to tell me in his last days, almost always some fun detail from his boyhood where nature was a wild, vivid and abundant protagonist in almost every adventure and misadventure. Certainly Kenya’s megafauna featured in many of Dad’s stories, but it was the everyday memories that have stayed with me – from learning how to trap doves for the evening meal to climbing high into a tree to catch a butterfly for a teenage crush (the latter a charming and surprising detail as I held his busted-up knuckles and meaty old mechanic’s hands in mine).

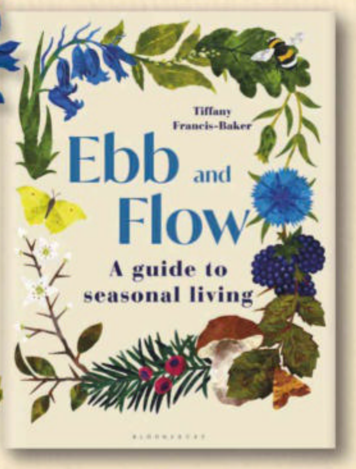
In the discourse around the environment and the natural world it can often feel like there are only two gears – awe and outrage. The temptation for natural history and science communicators to ‘play to the crowd’ by dialling up nature’s feel-good factor, or (rightly) vent at the many issues threatening our beautiful planet, means we can miss the opportunity to share the moments where nature catches us in a fall.

In the end, I think Dad needed to be alone as he slipped away on the one night that exhaustion got the better of me. I woke up after a welcome good night’s sleep at home to the dawn chorus, and a phone call. It’s been a while but I think I’ll set my alarm for this year’s International Dawn Chorus Day, on the first Sunday in May, and enjoy life’s bittersweet symphony once more.

Gillian Burke is a biologist, writer, film-maker, presenter and podcaster. She was part of the BBC Two *Watches* team from 2017-25.

NINA CONSTABLE

Refresh your spring reading with Bloomsbury Wildlife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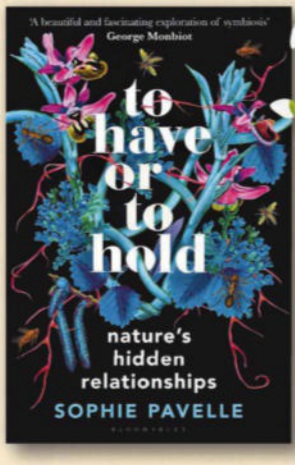
'A beautiful and fascinating exploration of symbiosis' George Monbiot
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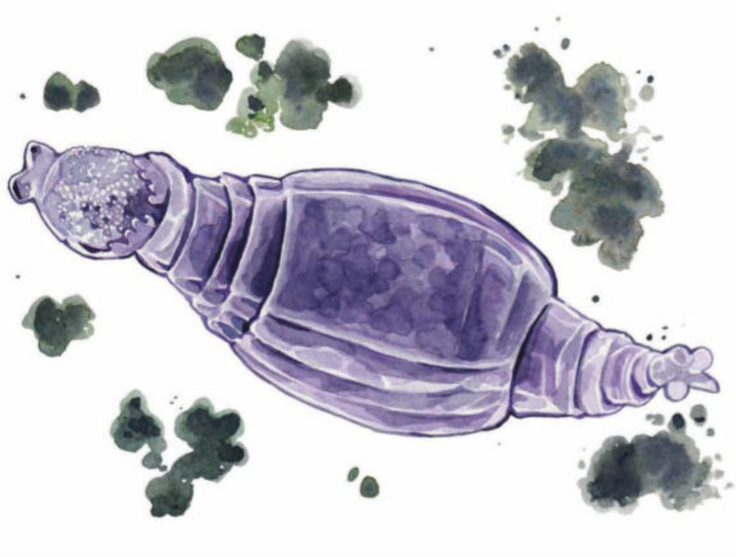
FEMALE OF THE SPECIES

BDELLOID ROTIFER

The secret to evolutionary immortality, minus males



Not only can the bdelloid rotifer reproduce asexually, it can survive for thousands of years in a state of frozen animation

IF THE BDELLOID ROTIFER could talk, she'd tell you sex is overrated. These microscopic relatives of the flatworm haven't had so much as a sniff of sex for some 80m years – a commitment to celibacy unmatched in the animal kingdom. All 450 species of this class of rotifer are female. No males have ever been described. Bdelloids make their home in brackish water, such as puddles (cute) and sewage treatment tanks (less so), which might not be terribly enticing on a dating profile. But these self-replicating sisters care not, for they've cracked the conundrum of how to survive without the genetic shuffling of sex.

The standard explanation for the existence for sex is that it increases genetic diversity, which helps species stay ahead of harmful mutations and ever-evolving parasites. Asexual species are therefore expected to have a shelf life of around 100,000 generations. The bdelloids' flouting of this rule has earned them a reputation as 'evolutionary scoundrels', forcing us to consider the whole question of sex.

Their evolutionary longevity is an area of continuing investigation. One of the secrets seems to be that they 'steal' genes from other life-forms, possibly through the stuff that they eat. The bdelloid diet isn't exactly enviable – which, given their living conditions, is hardly big news. They mostly survive on organic detritus – dead bacteria, algae and protozoans. In other words, pretty much anything they can fit in their mouths.

Some scientists think that the bdelloids can extract DNA from their dinner and spruce up their own genome by a process called 'horizontal gene transfer'. Studies have shown that up to 10 per cent of the active genes in these rotifers could be pirated from other species. All told, the bdelloids appear to have adopted a Frankenstein collage of foreign DNA from more than 500 other species. Whether that's through ingestion or not is up for debate, but these pilfered genes could be the reason for another bdelloid superpower: their epic resistance to drought and radiation.

If nature had an edition of the TV reality show *Survivor*, the bdelloid rotifers would probably be the last animals standing. These extremophiles can survive several years of desiccation and high blasts of radiation, beating even the notoriously indestructible tardigrade in the hard-nut stakes. A Russian scientist recently resuscitated rotifers that froze in ancient Siberian permafrost during the latter part of the Pleistocene – some 24,000 years ago. Once thawed, the first thing these ancient females did was start pumping out perfect clonal daughters.

The bdelloids are able to survive and produce viable replicas of themselves because their mosaic of stolen genes codes for enzymes that give them the remarkable ability to repair their shredded DNA. The temporary water sources they call home routinely dry out, leaving the bdelloids essentially mummified for potentially years while they wait for the next rainfall. Such dehydration has the same damaging effect on their DNA as radiation (if less extreme), and their stolen genetic repair kit helps them patch things back up. As an added bonus it's likely this is the bdelloids' secret to surviving millennia without males. The process of shattering and reconstructing their genome looks like it provides the bdelloids with the same evolutionary benefits as sex.

This is huge news. Until the bdelloid rotifer came along, sex had cornered the market on shuffling the genome. Now we've discovered there's at least one other way (males take note). ●

Lucy Cooke is a broadcaster, zoologist and author of *Bitch: What Does It Mean To Be Female?* The Penguin paperback is on sale now.

BBC SOUNDS

Catch up with Lucy's three-part BBC Radio Four series, *Political Animals*

ILLUSTRATION BY HOLLY EXLEY

It is estimated that around 500,000 wild red grouse are shot every year

RED GROUSE: BEN HALL/NATUREPL.COM

OPINION

"Why should wildlife lose to businesses underpinned by criminal activity?"

MARK CARWARDINE

IT'S HARD TO BELIEVE THAT, AFTER decades of campaigning, driven grouse shooting – and all the affiliated wildlife slaughter and habitat desecration – continues on a truly industrial scale. It's not cheap. People pay thousands of pounds a day for the privilege of killing as many red grouse as possible. Inevitably, shooting estates are obsessed with producing artificially high numbers of grouse to meet the demands of their clients and maximise profits, and annihilating all the predators is central to their entire operation.

Quite simply, predators aren't tolerated on most grouse moors. Foxes, weasels, stoats, crows and all sorts of other wildlife are mercilessly trapped, snared, shot and sometimes poisoned. Some of this is legal (albeit inhumane – few of the animals are killed instantly) but much of it is against the law. The scale of the illegal killing of golden eagles, white-tailed eagles, peregrine falcons, short-eared owls, badgers, hedgehogs and, of course, hen harriers (a red-listed species whose future prospects rely almost entirely on the proper management of their moorland home) is shocking.

Managers of driven grouse shoots argue that curlew, golden plover and some other ground-nesting waders benefit from this intensive predator control. Maybe they do. But they also thrive on numerous nature reserves without predator control – and there's no denying that most wildlife faces decimation on grouse moors.

> "All sorts of wildlife is mercilessly trapped, snared, shot and sometimes poisoned on grouse moors"

Let's not forget the red grouse themselves. It's estimated that more than 500,000 of them are shot in an average year (although, disgracefully, there is no statutory requirement to count – let alone record – the annual tally). According to a report by the League Against Cruel Sports, 40 per cent are wounded, rather than killed outright, so it's a humane issue as well as a conservation one.

The shooting takes place on upland heather moorland. Rich in wildlife, and critical for climate control and flood prevention, this habitat is predominantly found in Britain (we harbour 75 per cent of the world total). There are around 310 estates engaged in grouse moor management, managing as much as 1.8m hectares of this internationally important land.

But it's being 'managed' to produce a monoculture for red grouse shooting. It is no different to over-managed farmland – except it is being used for 'sport' instead of food. It is being drained, overgrazed and burned, causing a mixed bag of additional problems. Burning kills rare snakes and amphibians, for example, and – according to the Climate Change Committee – on grouse moors it emits 260,000 tonnes of carbon dioxide every year.

Proponents of driven grouse shooting argue that it provides 1,500 jobs for everyone from gamekeepers and beaters to people in tourism and hospitality. Assuming the figure is correct (it came from a 2021 parliamentary debate on the subject) it makes the industry a surprisingly small employer given the vast areas of land involved.

Studies by Rewilding Britain, the RSPB and others show that the benefits of a change in land management could potentially dwarf the local and limited economic benefits of driven grouse shooting through wildlife and outdoor tourism (not to mention the economic benefits of fewer greenhouse gases and improved flood management).

AT A GLANCE

- Red grouse are shot by a small minority of people, who regard it as a sport, on upland heather moorland mostly in Scotland and northern England.
- Attempts to rear red grouse have failed – they can't be bred to order like pheasants – so it is wild birds that are being hunted.
- There are no official figures as to how many red grouse are shot per year, but an estimate of 500,000 is the most widely accepted figure from work by the likes of Wild Justice and Animal Aid.
- Driven grouse shooting involves a line of 'beaters' with dogs flushing the grouse towards hunters, who lie in wait ready to shoot as the birds fly overhead.
- It's seen as controversial because driven grouse shooting estates have a long history of killing vast numbers of local wildlife – including protected birds of prey – and severely damaging the important heathland habitat.

Some conservation groups are arguing for a licensing system and, indeed, one has just been introduced in Scotland. Some hope it will become a blueprint for the rest of the UK. But with so little enforcement few estates will ever get caught – and it just hands them an unjustified stamp of legitimacy.

My view is that driven grouse moors cause so much ecological damage – and always will, licence or no licence – that they must be banned altogether. Why should wildlife lose to businesses, many of which are underpinned by criminal activity, prioritising profit above all else, for a repugnant 'sport' pursued by a tiny elite? It doesn't make sense.

Want to comment?

Share your thoughts on Mark's column by sending an email to wildlifeletters@ourmedia.co.uk

Mike Dilger's

WILDLIFE SPECTACLES

The broadcaster, naturalist and tour guide shares the most breathtaking seasonal events in the world

LIFE IS GOLDEN

GOLDEN JELLYFISH OF PALAU

On a tiny Pacific island, millions of jellies follow a strict schedule for their daily sun worship

WILDLIFE SPECTACLES THAT dominate both streaming platforms and column inches inevitably tend to come from the 'fur and feather brigades'. Given that many mammals and birds are often colourful, large, biologically well-known and with interesting behaviours, this 'wildlife chauvinism' can more easily be understood.

However, some biological phenomena from the 'less sexy' taxonomic groups can be just as enthralling, with Palau's golden jellyfish the supreme example.

Consisting of more than 250 islands in the Micronesian subregion of the Pacific Ocean, Palau is the 16th-smallest country in the world. A significant proportion of its economy relies on tourism, especially diving, with its barrier reefs, coral walls, World War II wrecks and celebrated Jellyfish Lake the most important attractions.

The 6ha lake lies on the small island of Mecherchar, a 20-minute trek through forest from the shoreline. It is home to millions of jellyfish, the vast majority of which are golden jellyfish. Though the lake appears cut off from the surrounding sea, the calcareous nature of the island's bedrock means it is in fact connected by a series of underground

Jellyfish Lake and the lagoon

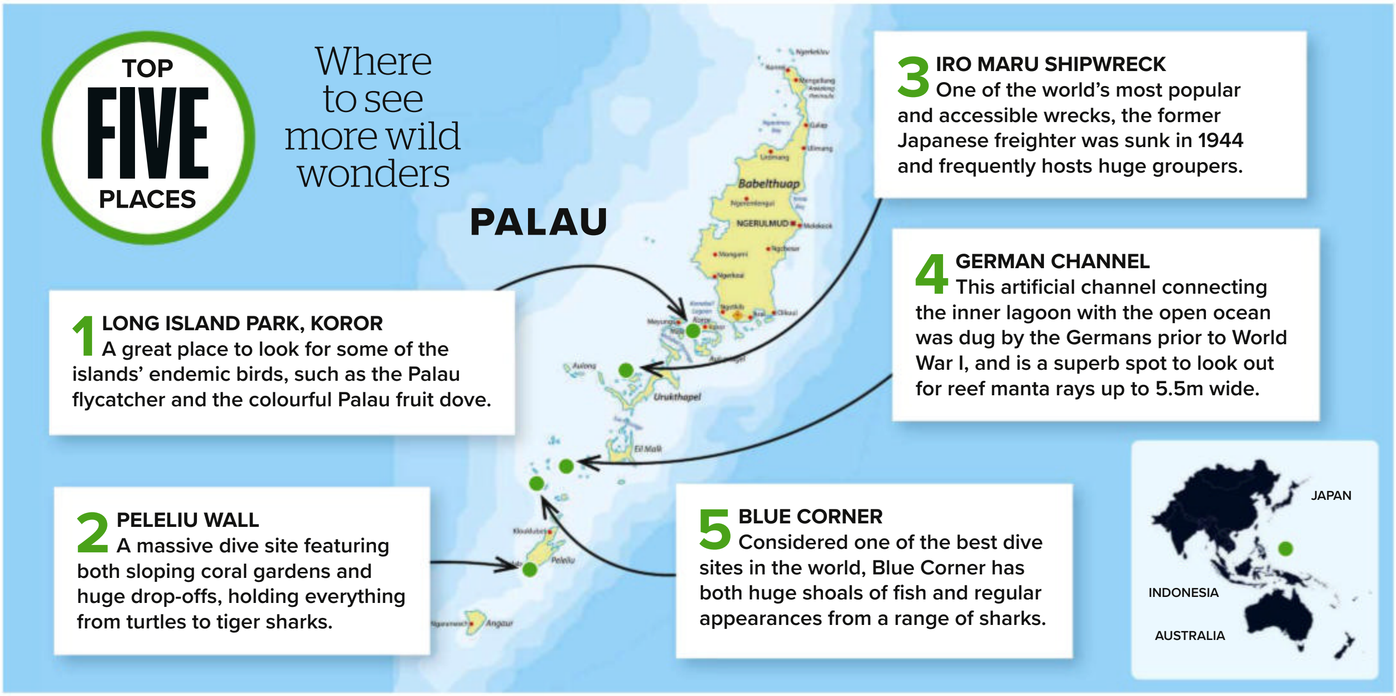
Did you know?

Evolving without significant predators for some 12,000 years, the golden jellyfish (actually a subspecies of spotted jellyfish) has such a mild sting that you can swim safely among a swarm.

> "A wall of pulsating, rotating jellyfish should be heading straight for you"

GOLDEN JELLYFISH: ALEX MUSTARD/NATUREPL.COM; JELLYFISH LAKE: REINHARD DIRSCHERL/GETTY

Sunlight provides golden jellyfish with nourishing sugars, via the algae that live symbiotically in their tissues



TOP FIVE PLACES

Where to see more wild wonders

1 LONG ISLAND PARK, KOROR
A great place to look for some of the islands' endemic birds, such as the Palau flycatcher and the colourful Palau fruit dove.

2 PELELIU WALL
A massive dive site featuring both sloping coral gardens and huge drop-offs, holding everything from turtles to tiger sharks.

3 IRO MARU SHIPWRECK
One of the world's most popular and accessible wrecks, the former Japanese freighter was sunk in 1944 and frequently hosts huge groupers.

4 GERMAN CHANNEL
This artificial channel connecting the inner lagoon with the open ocean was dug by the Germans prior to World War I, and is a superb spot to look out for reef manta rays up to 5.5m wide.

5 BLUE CORNER
Considered one of the best dive sites in the world, Blue Corner has both huge shoals of fish and regular appearances from a range of sharks.

fissures and cracks to the nearby lagoon. Seawater filters in at high tide, linking the lake with the marine ecosystem.

The lake, which is no more than 30m deep, is classified as 'meromictic', meaning it has distinct layers of water that do not mix. The top 13m, to which the golden jellyfish are confined by day, is penetrated by sunshine and suffused with oxygen, resulting in good clarity. Below this is a 2m 'pink layer' dominated by bacteria. The zone below spans from a depth of 15m down to the lake's bottom and is devoid of both light and oxygen. Here, the noxious gas hydrogen sulphide is the commanding force.

Golden jellies are believed to have been present ever since a sudden and temporary sea rise filled the lake around 12,000 years ago. In isolation, the jellyfish evolved into a subspecies with vastly reduced appendages compared to its lagoon ancestors. It also lost most of its stinging cells, due to lower predation rates in the lake.

A golden jellyfish drifts towards the mangrove-lined banks of Jellyfish Lake

> "During the day the jellies constantly rotate in an anticlockwise direction"

The golden jellyfish can capture zooplankton, but obtains most of its nutrition from algae in its tissues. In return for accommodation and transport, the algae supply their hosts with photosynthesised sugars. The jellyfish undertake a daily migration to ensure that the algae are able to harvest as much light as possible. As the sun rises, they move east until they reach the shadow formed by the rocks and trees along the lake shore. Always keen to remain in the sunlight-bathed water, they then return westwards as the sun passes overhead, once again stopping at the shadow. During the course of the day, the jellies constantly rotate in an anticlockwise direction to ensure that their all-important algae receive constant and even sun coverage. At night, the jellies repeatedly drop down to deeper water, presumably to acquire nitrogen and other trace chemicals needed by the algae.

Due to the high levels of toxic hydrogen sulphide in the lake's lower reaches, scuba diving is not permitted, but snorkelling is encouraged. As with most wildlife spectacles, timing is of the essence, and if you can arrive in the morning when the jellies are on the move, then a huge wall of jellyfish should be heading straight for you. Swimming among these pulsating and rotating creatures should be a memorable, pleasurable and pain-free experience, and help to convince you – even if just for a day – why jellyfish deserve to be raised to the pedestal normally occupied by our more vaunted faunal classes.

LOOK CLOSER

Stand clear of the edge

The golden jellies must keep away from the lake's margins to avoid the predatory sea anemone *Entacmaea medusivora*. Living on shallow mangrove roots and rocks surrounding the lake, the anemones devour any jellyfish that brush against their tentacles.

Entacmaea medusivora

Jelly stages

The jellyfish's life-cycle takes on two life-forms: the polyp stage and the medusal (adult) stage. Tiny polyps attach to firm surfaces along the lakeside, and in addition to budding, they produce medusae, which mature into adults. These medusae reproduce sexually by spawning to produce planulae, which transform into polyps.

The wrath of El Niño

El Niño weather events can hugely reduce the golden jellyfish population, as warmer water and reduced rainfall increase the lake's salinity. These conditions occurred in 2015-2016, when the medusae completely disappeared. By 2019 the population had bounced back.

NEXT MONTH

The epic polar odyssey of the wandering albatross

GOLDEN JELLYFISH: JUERGEN FREUND/NATUREPL.COM; ANEMONES: BLUE PLANET ARCHIVE LLC/ALAMY; ALBATROSS: ALL CANADA PHOTOS/ALAMY

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Nick Baker’s

HIDDEN WORLD

The popular naturalist, author and TV presenter reveals a secret realm of overlooked wildlife

POISON ARROW

MANED RAT

It looks dashing, but don’t be fooled – its hairs are dangerously toxic

THINK OF A RAT AND YOU’VE ALMOST certainly got a mental image of a medium-sized grey or brown-furred rodent with a thin, naked tail, one of the 56 or so species belonging to the genus *Rattus*.

However, other rodents also carry the ‘rat’ moniker. One in particular, the maned or crested rat (*Lophiomys imhausi*) is so un-rat like that it stands out like a beacon from its rodent cohorts. In fact, it does things so differently that it has been given a sub-family of its own.

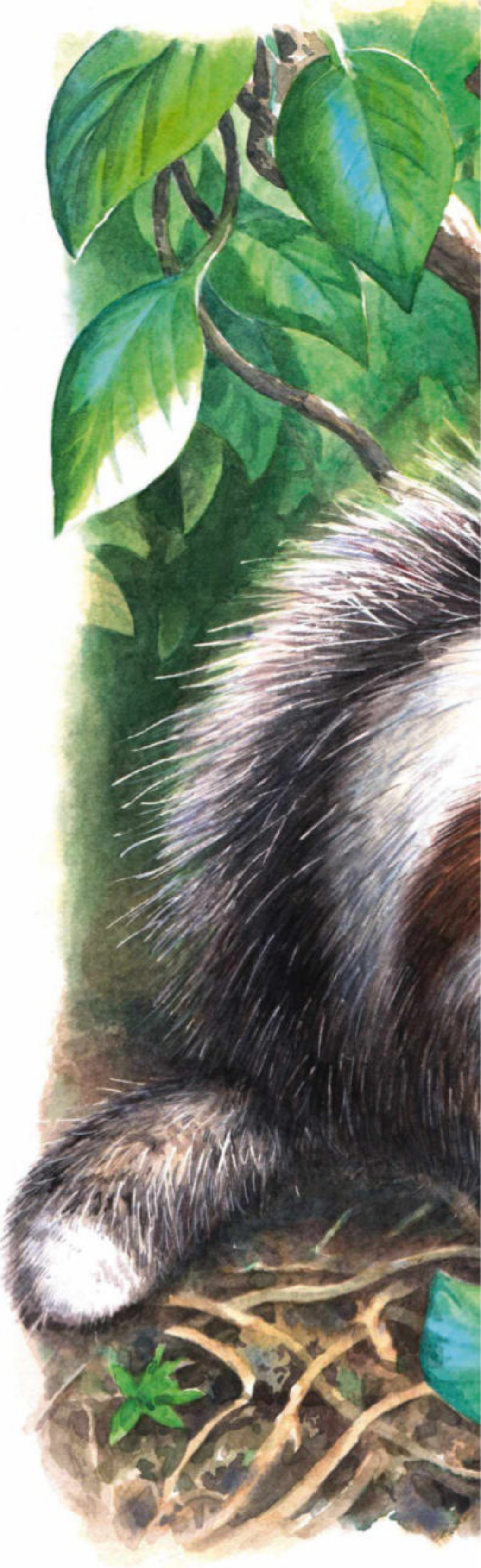
Covered in long, shaggy grey hair, with side-stripes of black and white that run the length of its body, a bandit’s mask, a white-tipped bushy tail and a bold white eyebrow stripe, it certainly cuts a dash, looking more like a skunk than a rat. When alarmed, it adds to the effect. Muscles under its skin cause the long hairs on its back to stand up, while those below the midline on its flanks become deflected downwards. The result is a parting of the hair along the length of each side of its body.

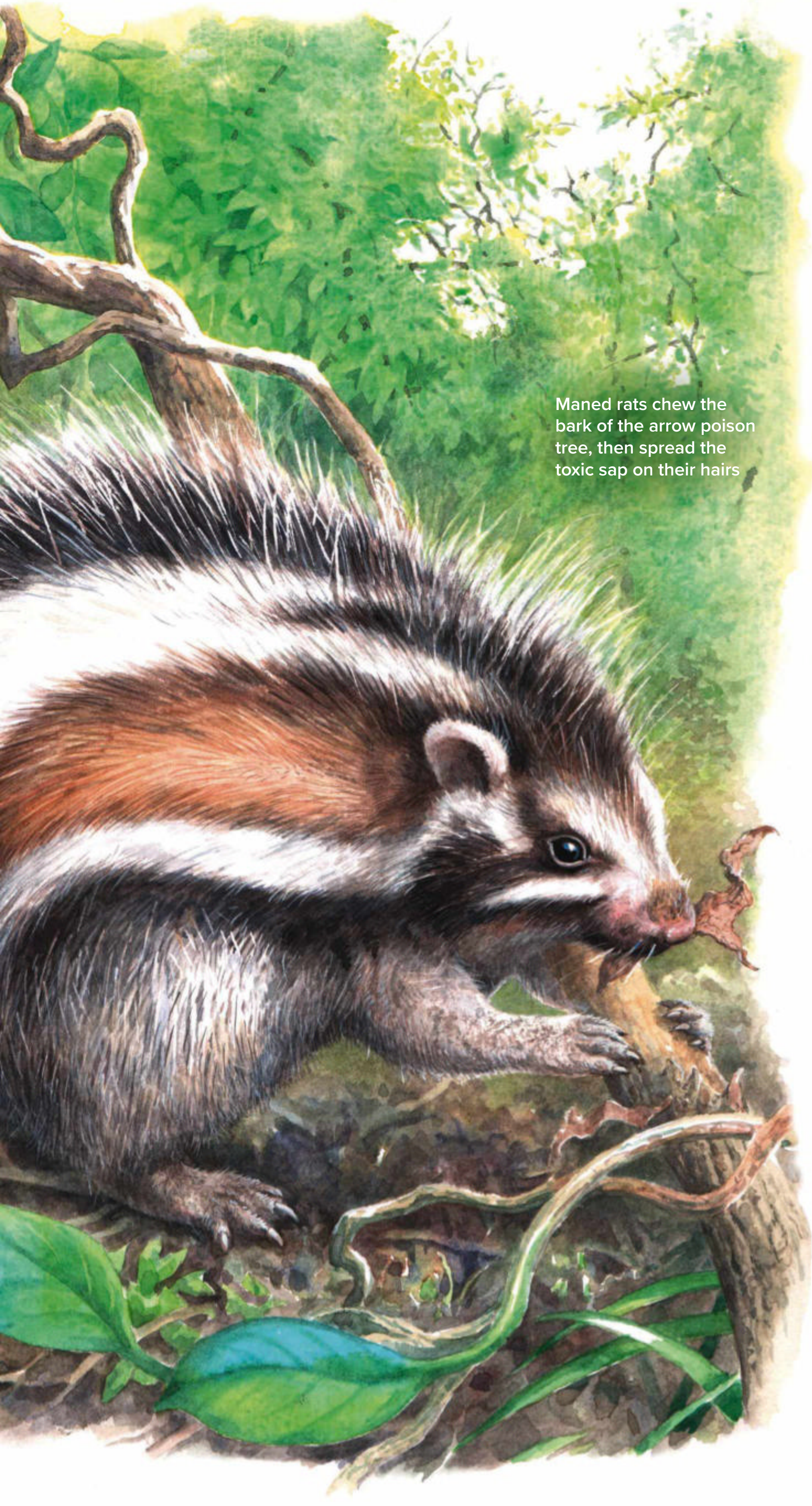
In nature, such a bold statement usually means something: a warning. For a long time, the maned rat’s display was supposed to be all bluster, a rare example of Batesian mimicry in a mammal – where an inoffensive creature mimics another with an effective defence. In the East African part of the maned rat’s range, the zorilla (a kind of striped polecat) or porcupine were supposedly the models on which the maned rat based its moves.

It has since been discovered that our rat has an association with the arrow poison tree (*Acokanthera schimperi*), which produces a powerful toxin known as cardiac glycoside. Somalian elephant hunters have long used the tree’s sap to tip their arrows, making them so potent that a single shot can stop an elephant’s heart.

The maned rat regularly chews the bark of this tree and then anoints itself with the resulting colloid, a mixture of sap and saliva. How it gets away with this is still a mystery (one theory is that its four-chambered stomach helps to denature the tree’s toxins), but the ‘why’ is ingenious.

By spreading the potent mix onto its hairs, it is the only mammal that deliberately acquires toxins from a plant and repurposes them for its own ends. As it turns out, our rat was not bluffing after all.



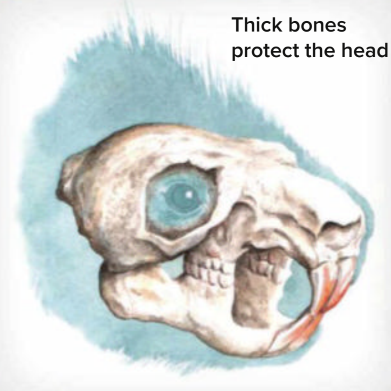

Maned rats chew the bark of the arrow poison tree, then spread the toxic sap on their hairs

“Any predators that take a bite get a mouthful of poison”

When it erects its body hairs, the rat exposes a pale patch of glandular skin, which is made all the more visible by the lie of the hairs that now frame the area in a black-and-white target, as well as shorter white hairs along a lateral line on each side of its body. On closer inspection, scientists have found that these hairs exhibit a unique micro-structure. Their middle section is hollow and the surface pocked with thousands of small holes, making them look like sponge fingers. The toxic liquid enters the hair and is quickly absorbed and wicked up by its interior fibres, then dries on to the large surface area.

Any predator that is foolish enough to ignore the rat’s obvious visual warning and take a bite ends up with a mouthful of poison-slavered hairs. These are highly effective, particularly when they come into contact with the mucous membranes inside the predator’s mouth. One small morsel of maned rat can cause breathing difficulties, vomiting, convulsions and even cardiac arrest. Dogs have apparently died after attacking a rat that has nonchalantly walked away from the encounter without so much as a scratch – giving a whole new meaning to the words ‘rat poison’.

LOOK CLOSER


Thick bones protect the head

Armoured skull

The maned rat also has an unusual skull. There are bony projections over its eyes, and the skull is thickened in places and covered in strange knobbly bumps. This is thought to act like an internal helmet, further protecting the rat from attack – but nobody is certain.

ILLUSTRATIONS BY PETER DAVID SCOTT/THE ART AGENCY

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Whales cruising in Greenland

White-tailed eagle

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ARCTIC CREATURES

Wildlife watching is part of every HX expedition and the Greenland itineraries do not disappoint. The ice-free periphery of the island is home to a vast, interconnected ecosystem supporting a huge variety of animals, from musk oxen and Arctic foxes to white-tailed eagles and snowy owls. Humpback, blue and fin whales teem along the coastline, while polar bears are occasionally spotted in the Northeast Greenland National Park. Visit

Prince Christian Sound

Vaigat Sound

from May to September for the best whale watching conditions and join an excursion in one of the ship's expedition boats. These smaller, nimble boats are ideal for exploring the dramatic coastline and spotting whales and dolphins, as well as six species of seal.

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SET SAIL

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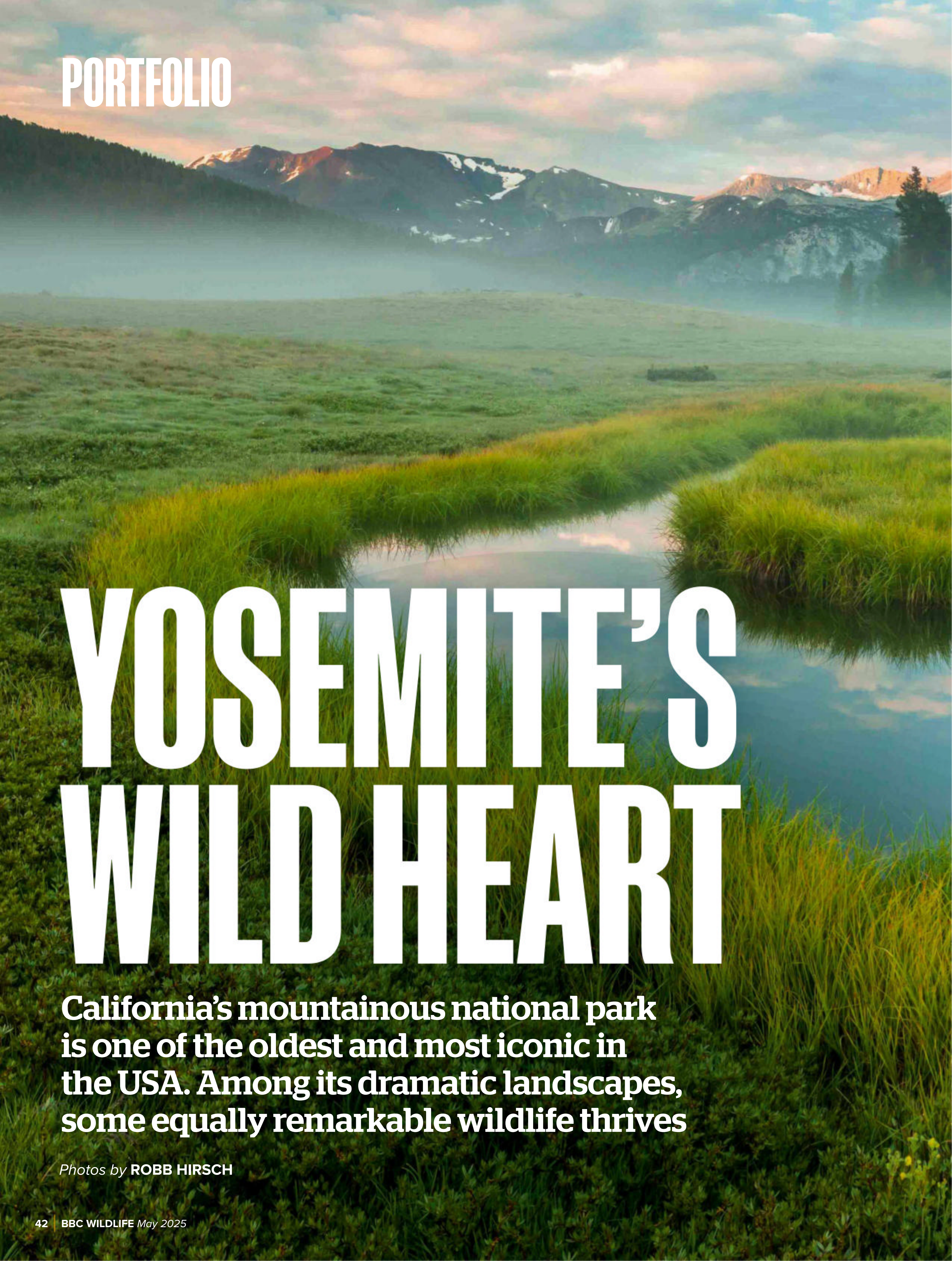


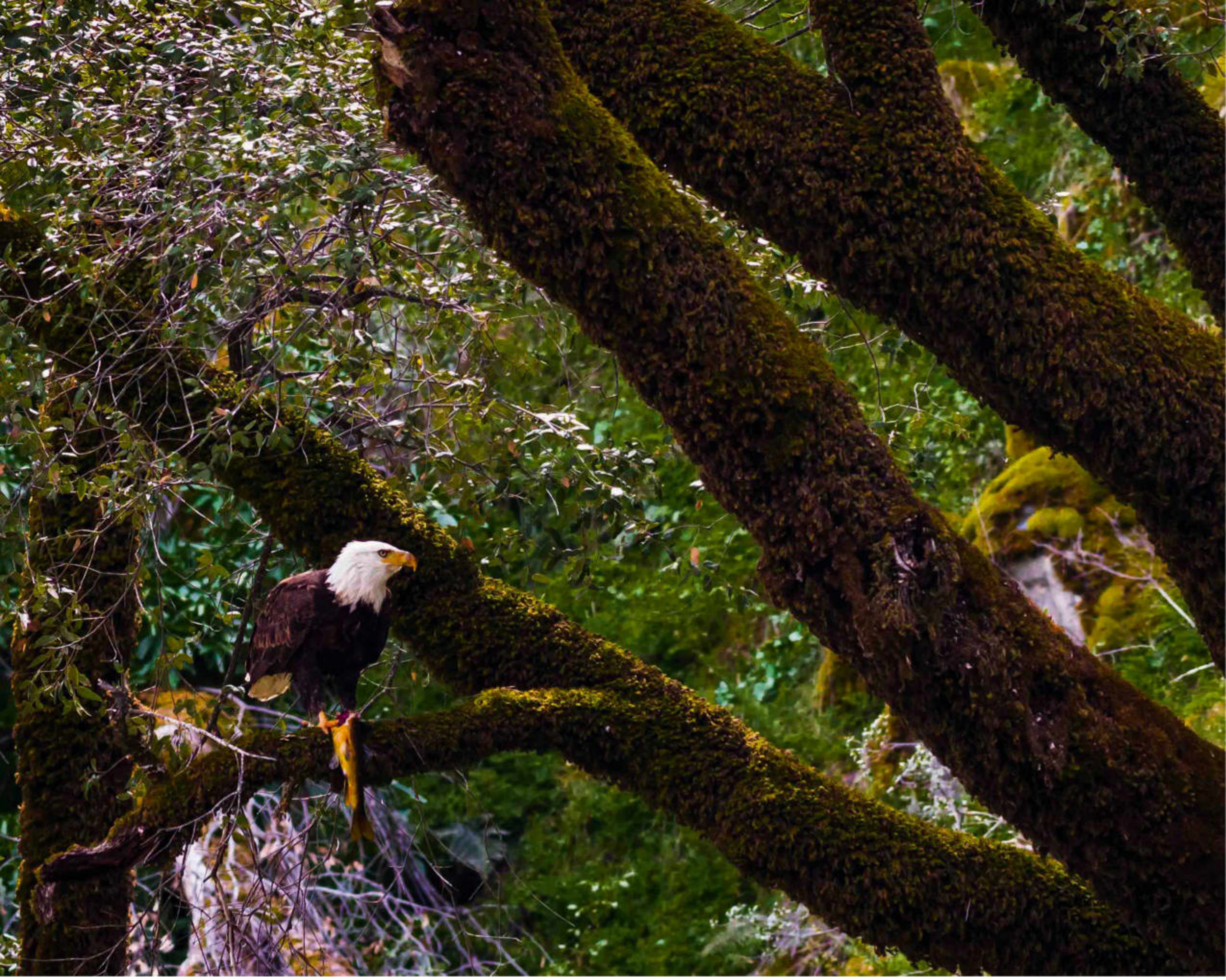
YOSEMITE'S WILD HEART

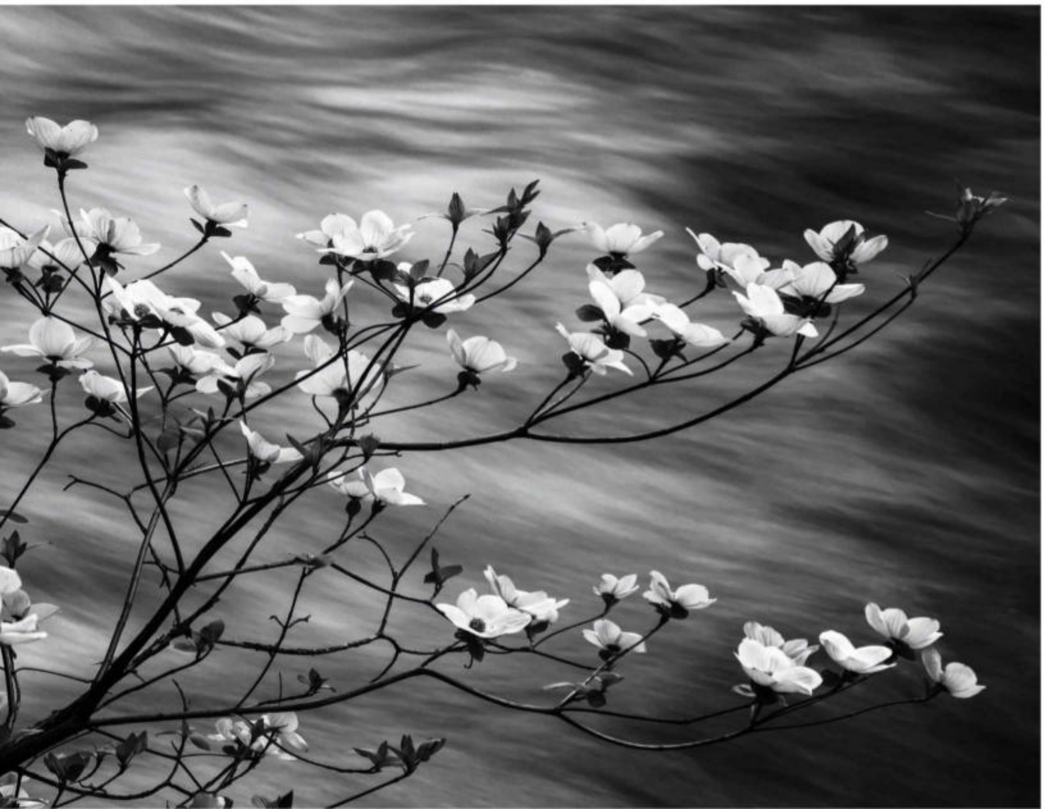
California's mountainous national park is one of the oldest and most iconic in the USA. Among its dramatic landscapes, some equally remarkable wildlife thrives

Photos by **ROBB HIRSCH**

Reflecting nature

A dawn mist veils the Dana Meadows of Yosemite National Park, northern California. Renowned for its towering waterfalls, deep valleys and soaring cliffs, "Yosemite is considered by many a *landscape* park," according to photographer Robb Hirsch, "and its wildlife is often overlooked." So Robb's work focuses both on landscape and on the remarkable flora and fauna that thrive in the park's 3,000km², 95 per cent of which is designated Wilderness – the USA's highest level of protection for public land.



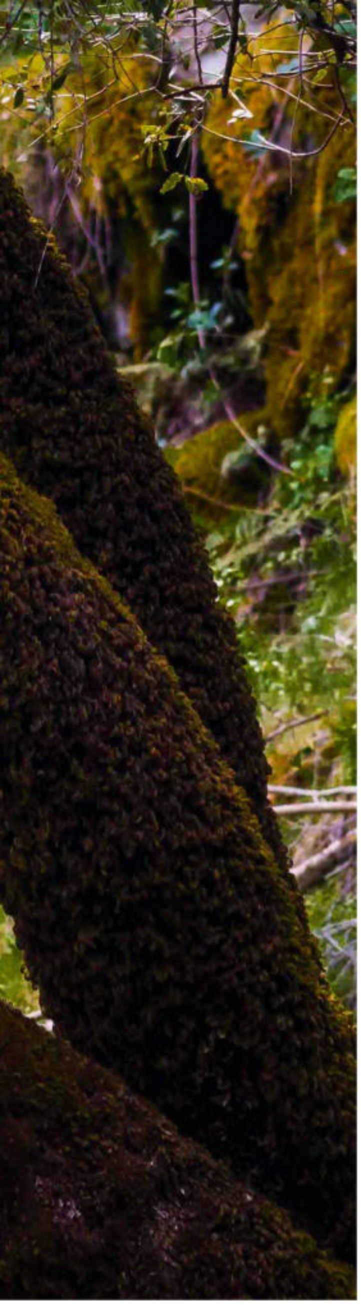


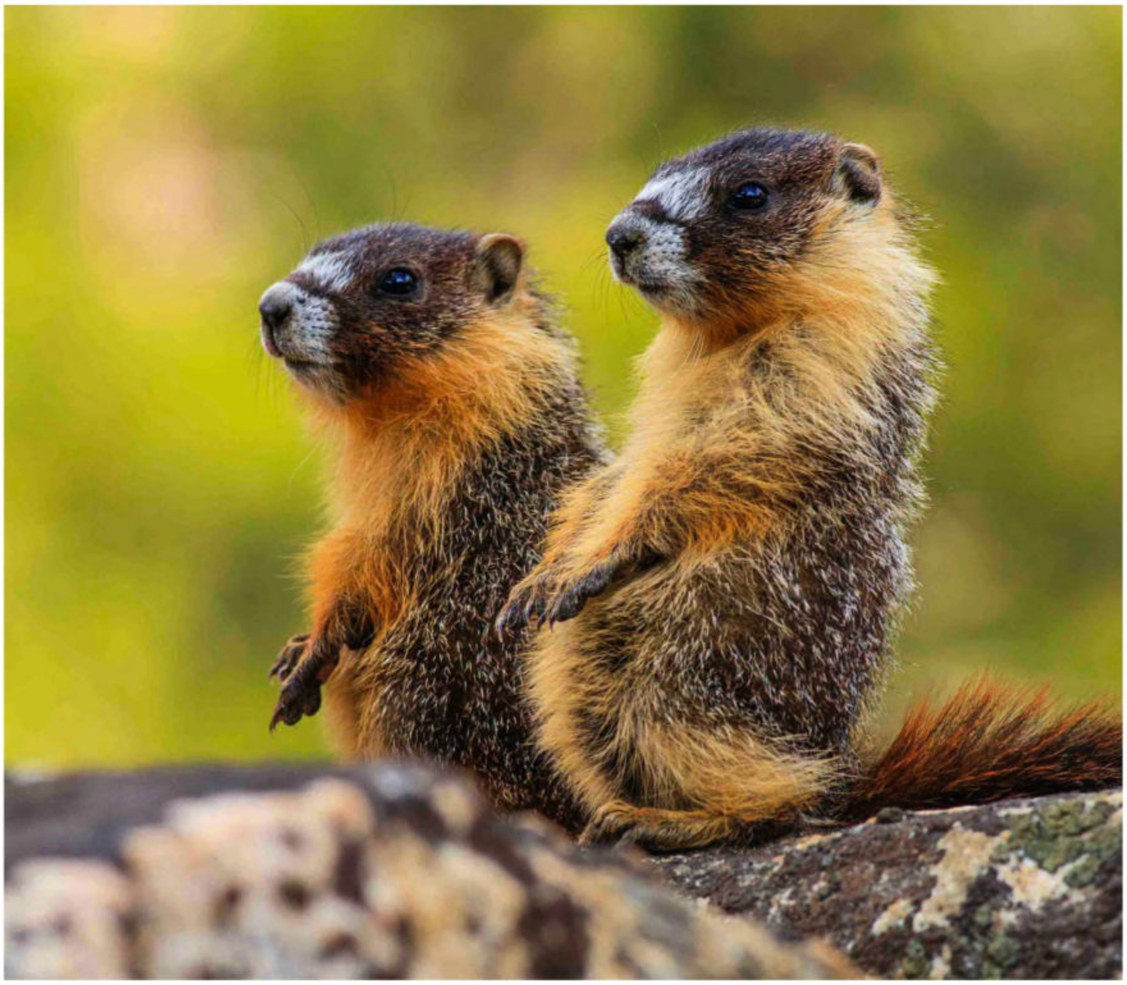
Catch of the day

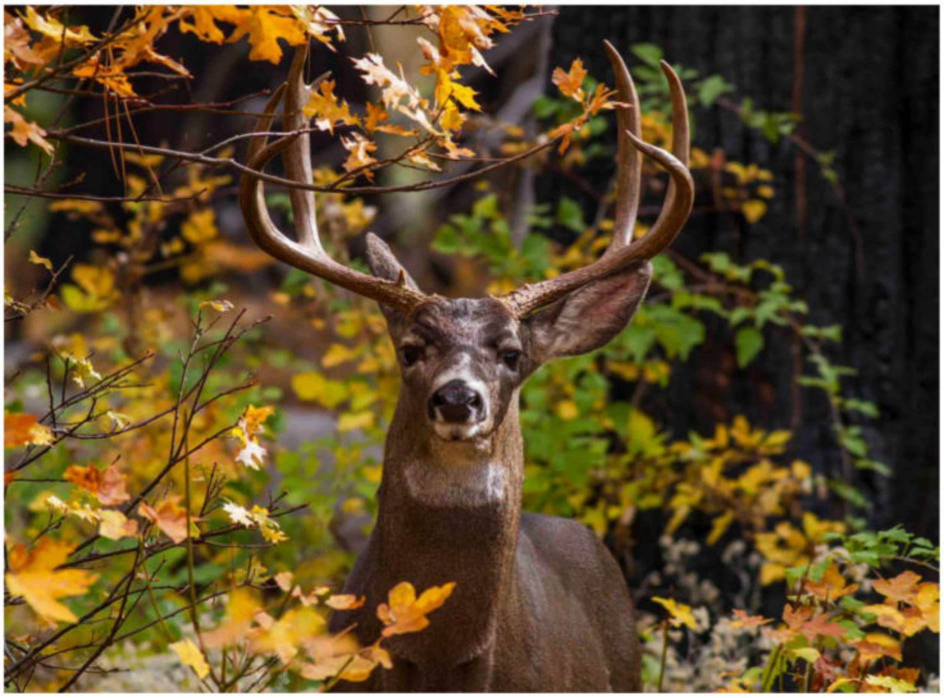
A bald eagle with a catch of trout perches in an oak tree along the Merced River. These raptors are primarily fish specialists but also hunt other birds, rodents and reptiles, and feed on carrion. They mate for life and are seen in only a few areas of Yosemite.

Mountain in bloom

The large and showy white flowers of mountain dogwood, here by the Merced River, emerge before the leaves to bloom in early May. The species has adapted to life under the canopy by evolving to photosynthesize with only a tiny amount of sunlight.





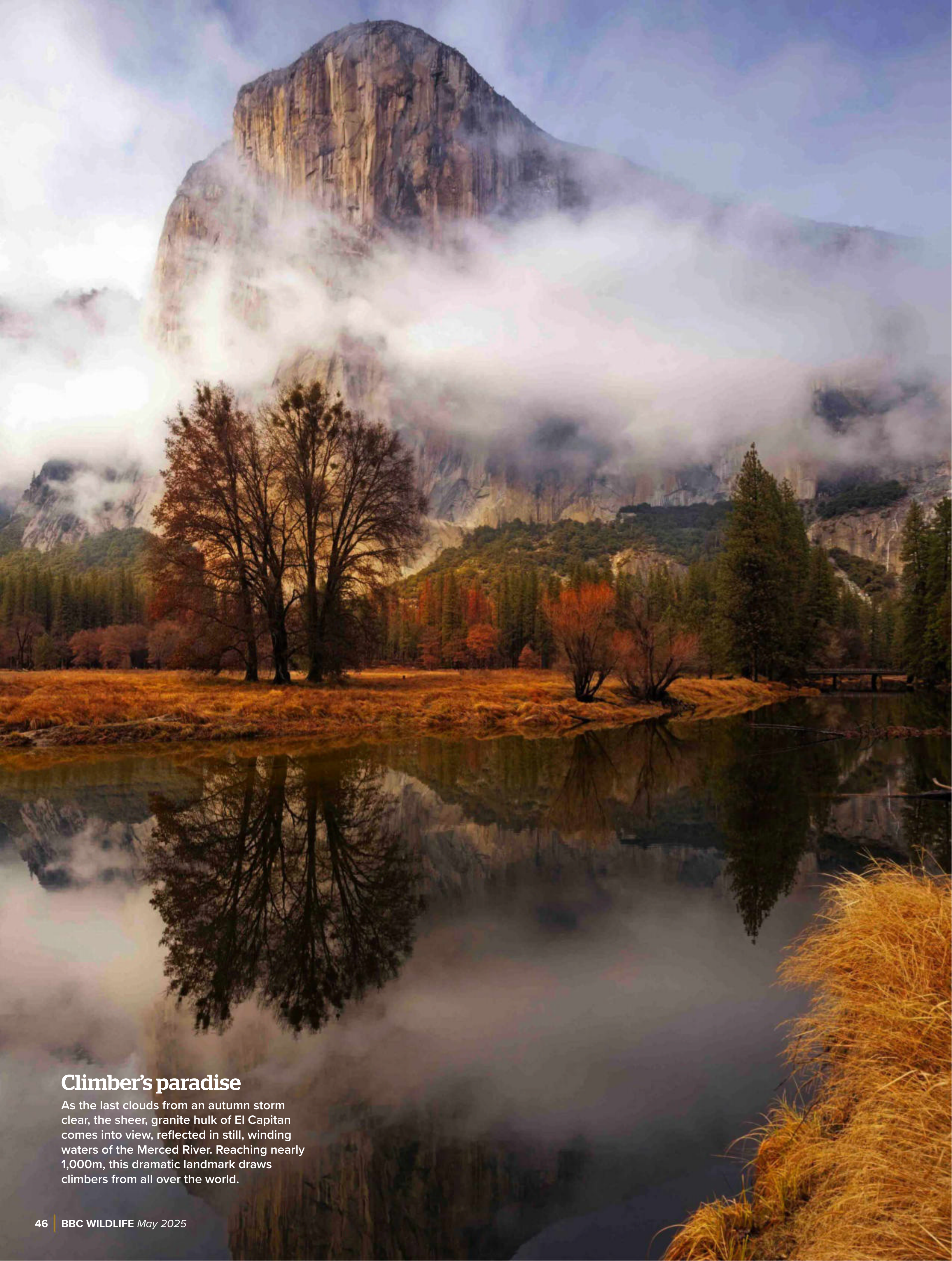


Rock stars

The largest member of the squirrel family, yellow-bellied marmots – here a couple of youngsters – live in small colonies in the rocky uplands of Yosemite, mostly above 2,000m. They hibernate for up to eight months of the year, and during the months when they are active are known to whistle loudly to warn of nearby predators.

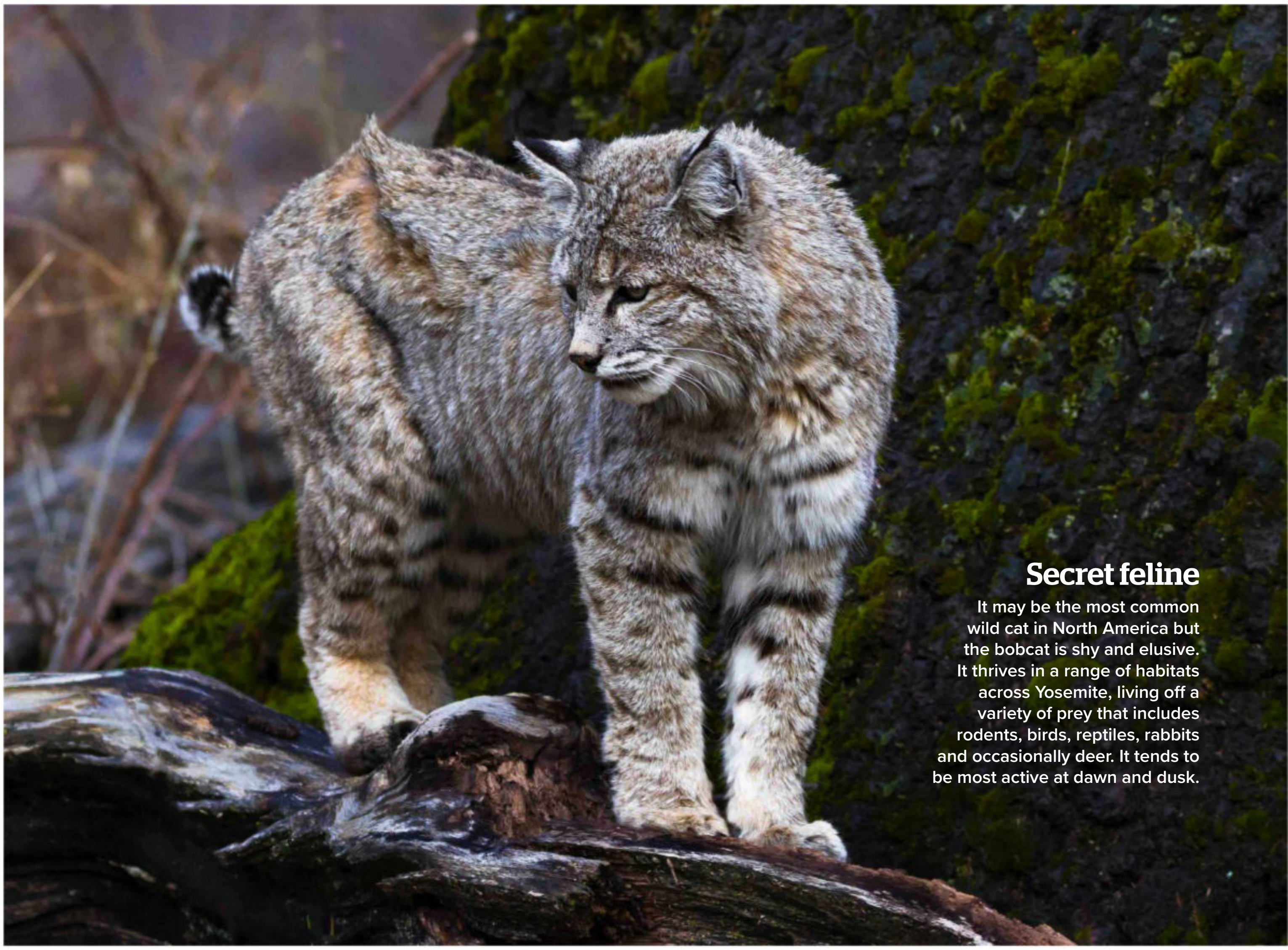
Lord of the forest

One of most common mammals spotted in Yosemite, mule deer – named after their large, mule-like ears – are wide-ranging. They are found as high as 3,000m but move to lower elevations in winter.



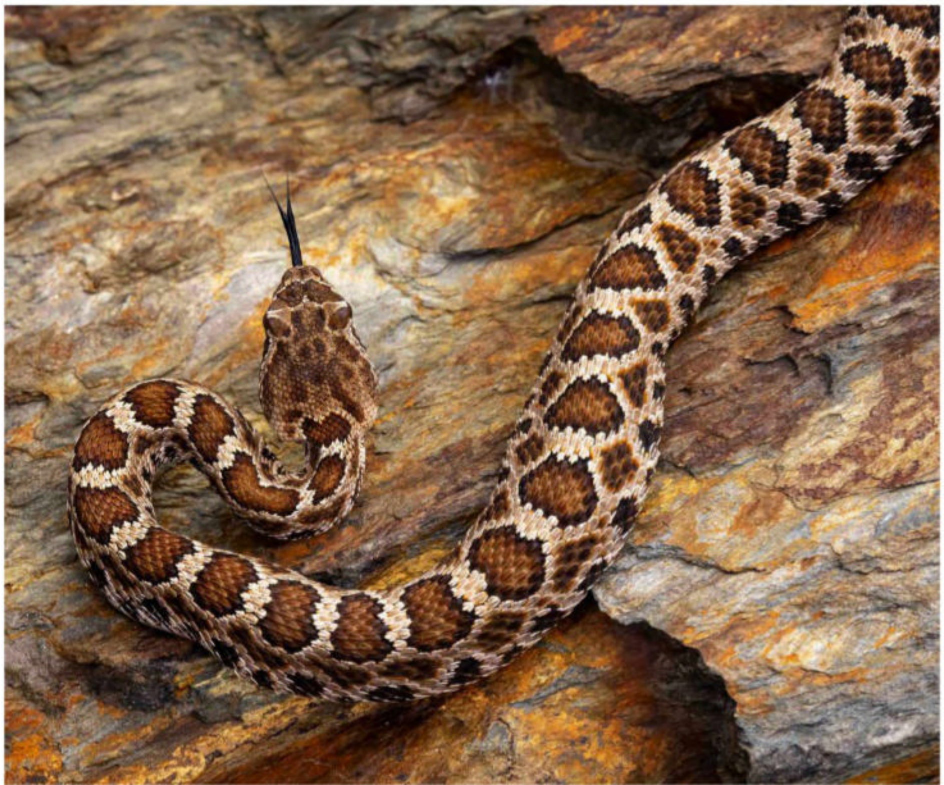
Climber's paradise

As the last clouds from an autumn storm clear, the sheer, granite hulk of El Capitan comes into view, reflected in still, winding waters of the Merced River. Reaching nearly 1,000m, this dramatic landmark draws climbers from all over the world.



Secret feline

It may be the most common wild cat in North America but the bobcat is shy and elusive. It thrives in a range of habitats across Yosemite, living off a variety of prey that includes rodents, birds, reptiles, rabbits and occasionally deer. It tends to be most active at dawn and dusk.



Writhe and rattle

Decorated with ornate patterning and subtle brown hues, the northern Pacific rattlesnake reaches more than a metre in length and is Yosemite's only venomous snake. The serpent identifies food – mostly rodents – by heat-detection, attacking with a killer bite, then following the scent of its wounded quarry.

ABOUT THE PHOTOGRAPHER

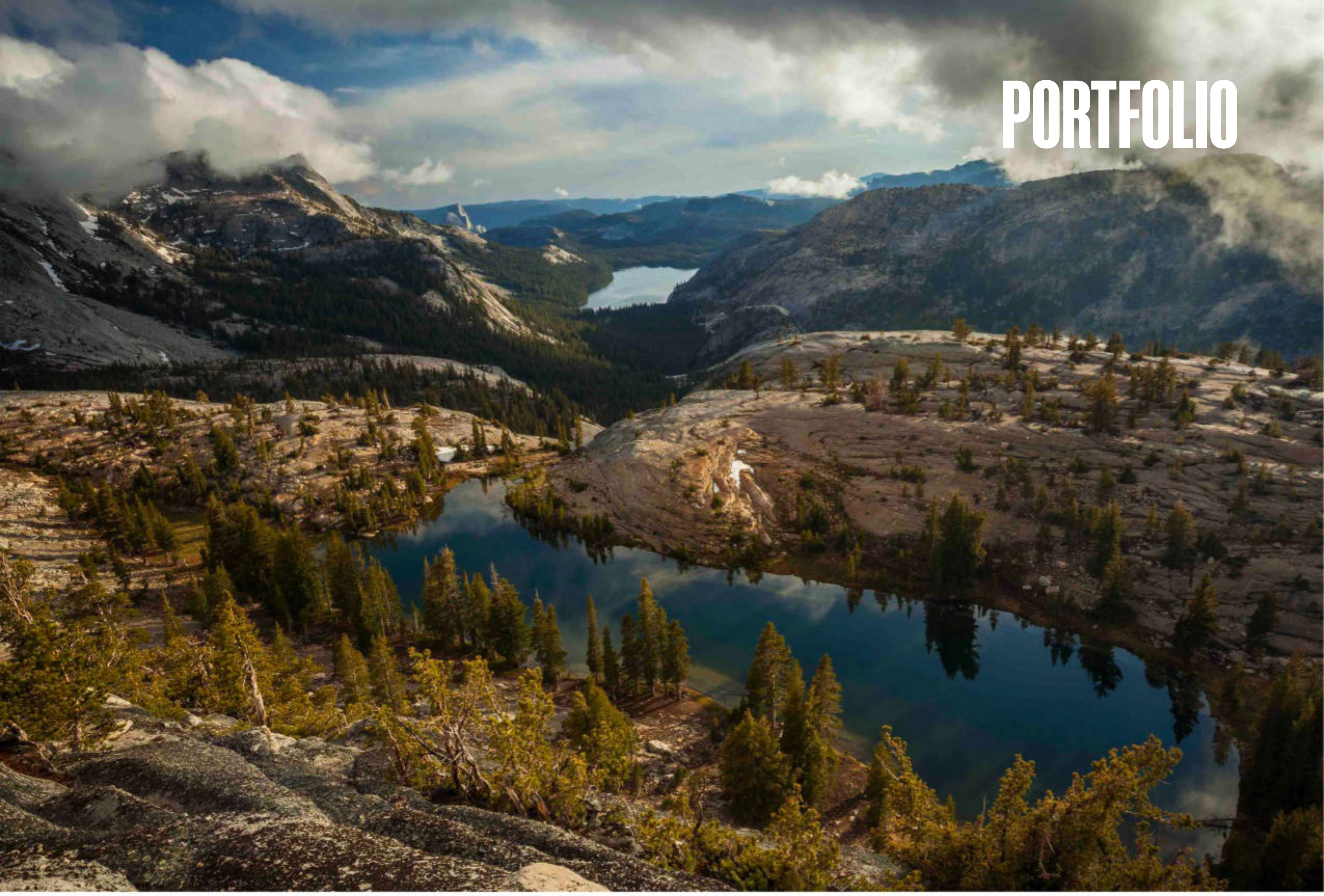
Robb Hirsch is a photographer from California. He is the author of *The Nature of Yosemite: A Visual Journey* (Yosemite Conservancy, £28.99). His new book with Beth Pratt, *Yosemite Wildlife*, is out in October.

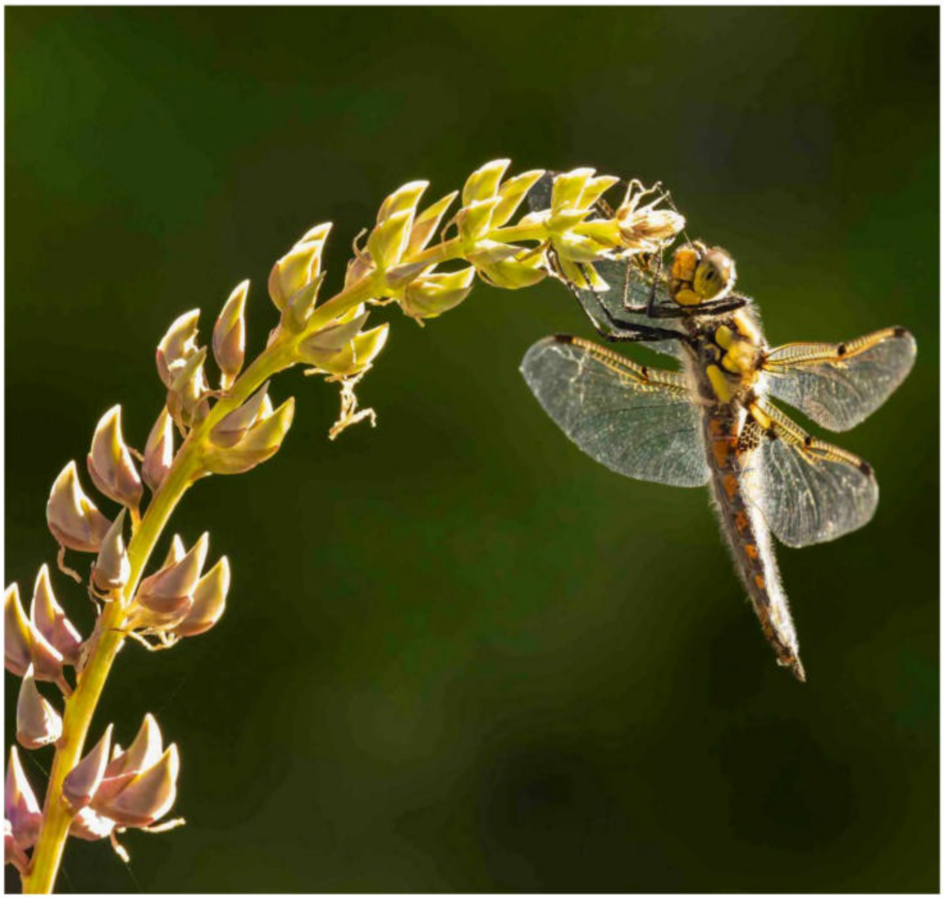
Snow patrol

Coyotes are a common sight in Yosemite in winter. They patrol the meadows, listening for rodents scampering through tiny snow tunnels. Having pinpointed the location of an unsuspecting victim, they pounce.

Tiny hunter

Clocking in at just 60-70g – about the weight of a plum – the northern pygmy owl is nonetheless a fierce and feisty predator, capable of taking down prey up to three times its size. Unlike many owls, it is active during the day, hunting by sight rather than sound. This individual is returning to its cavity nest with a Sierra fence lizard in tow.



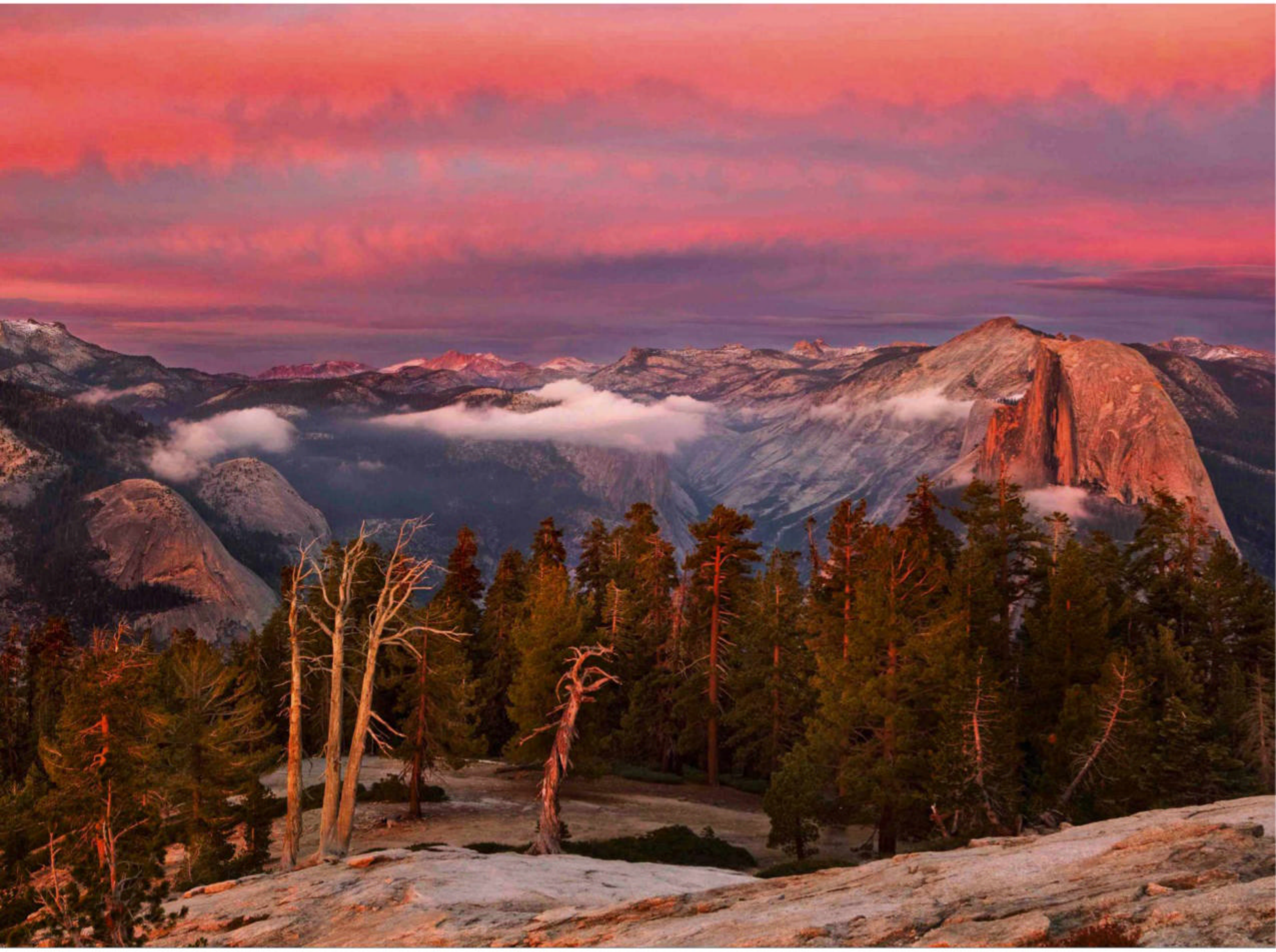


Mountain high

This is a spectacular view over Yosemite's rugged back country, with Tenaya Lake in the distance. The small body of water in the foreground is known as a tarn, created thousands of years ago by glaciers that carved out a depression in the granite, which then filled with meltwater.

Summer dragons

Dragonflies – such as this four-spotted skimmer, pictured on a lupine flower spike – abound in Yosemite's rivers and lakes in summer. These are aggressive aerial hunters, chasing down other flying insects on the wing, and are incredibly territorial.

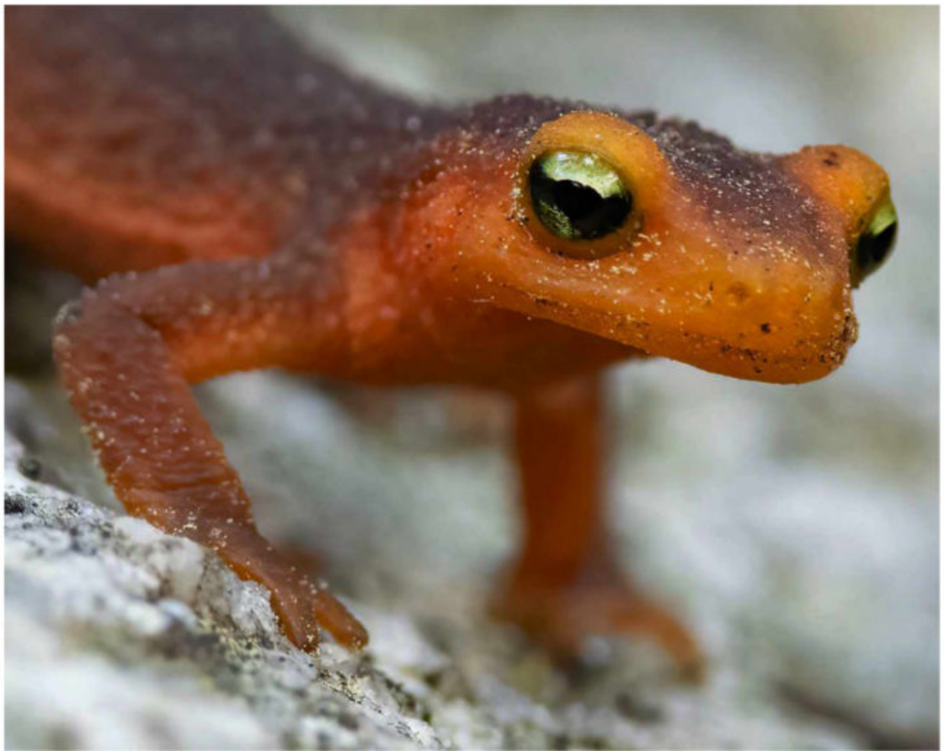


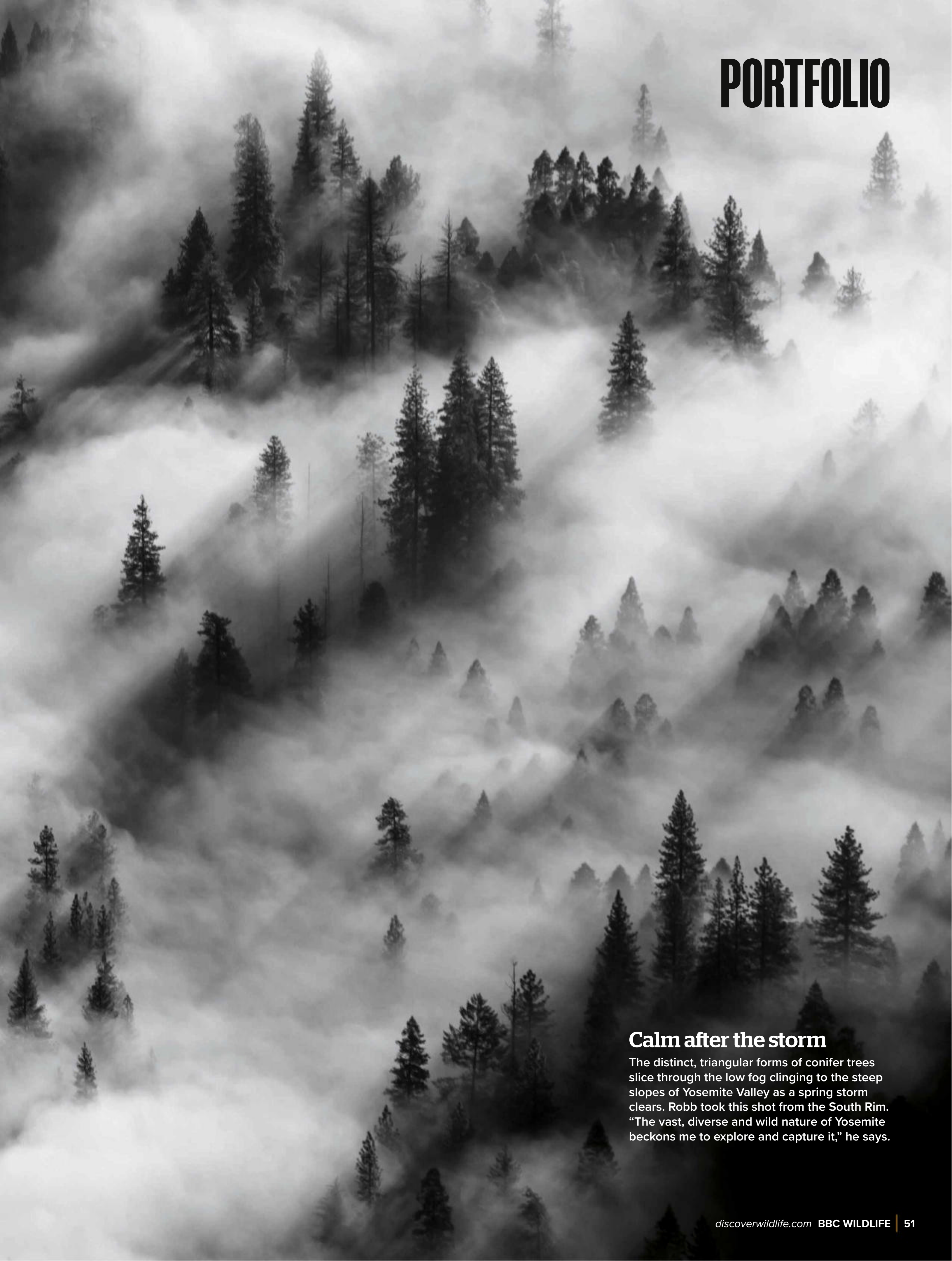
Standing sentinel

Pinks and purples wash the sky with colour as the sun sets, illuminating the grey rock of Half Dome, as viewed from Sentinel Dome. The distant peaks form the Sierra Nevada crest, which reaches a height of more than 4,000m.

Newt with a kick

Sierra newts spend most of their time on land but require fresh water, such as ponds, streams or rivers, for breeding. Glands in their skin produce a powerful chemical defence in the form of a potent neurotoxin, which is strong enough to kill most vertebrates if ingested. The garter snake is the notable exception, having evolved resistance to the toxin. Not surprisingly, it is the newt's main predator.





Calm after the storm

The distinct, triangular forms of conifer trees slice through the low fog clinging to the steep slopes of Yosemite Valley as a spring storm clears. Robb took this shot from the South Rim. “The vast, diverse and wild nature of Yosemite beckons me to explore and capture it,” he says.

We knew sea otters saved kelp forests. But we didn't know they could save estuaries, too

THE EN

Words by
RYAN WAGNER

Sea otters have helped transform the habitat of a Californian estuary, Elkhorn Slough

GINEERS

SEA OTTERS: RALPH PACE/MINDEN/NATUREPL.COM

The twin stacks of a power plant rise above seven miles of estuary and wetland at Elkhorn Slough

When seagrass began to flourish in the polluted Elkhorn Slough, scientists were startled

THE CLEAR, COASTAL WATERS OF MONTEREY Bay, California, are renowned as a diver's paradise and home to rich kelp forests teeming with life. Though biodiverse, Elkhorn Slough, an estuary at the mouth of the Bay, provides a striking contrast.

At the same time, sea otter numbers rocketed in the estuary. Were the two recoveries connected?

ELKHORN SLOUGH: LUCIANE COLETTI; OTTER: SEBASTIAN KENNERKNECHT/ MINDEN/NATUREPL.COM; SEAGRASS: BRANDON COLE/NATUREPL.COM

The waters of Elkhorn Slough are shallow and often murky, making it a challenging place to dive. “I don’t do it for fun, I can tell you that,” says Brent Hughes, a coastal ecologist at Sonoma State University. Yet, for more than two decades, Hughes has immersed himself in this habitat, blindly counting blades of seagrass as he gropes along the estuary’s silty bottom.

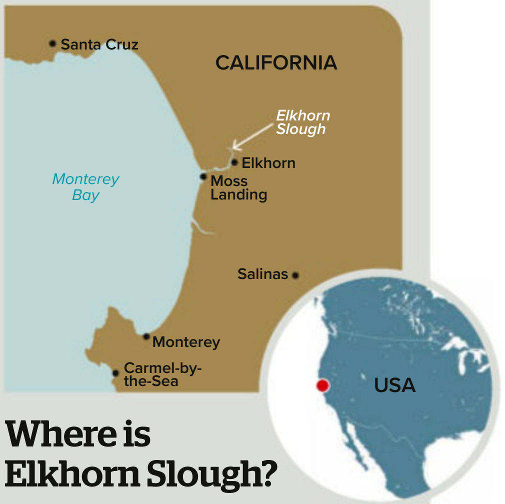
Like trees in a forest, seagrass is the backbone of Elkhorn Slough’s ecosystem. Its leaves form a flowing underwater meadow that provides shelter for juvenile fish and scaffolding for algae. Grazing invertebrates, such as sea slugs, feed on the algae and are themselves food for crabs. The entire ecosystem sustains more than 300 bird species, hundreds of harbour seals and sea otters. Beyond their role in supporting wildlife, estuaries such as Elkhorn Slough buffer flooding and sequester carbon at rates rivalling those of tropical rainforests.

But 20 years ago, Elkhorn Slough was in crisis. “It was not a pretty sight,” recalls Hughes. “There was very little seagrass and algal mats were everywhere.” The culprit was no mystery: agricultural runoff.

CALIFORNIA’S SALINAS VALLEY, dubbed the ‘salad bowl of the world’ for its intensive production of lettuce, broccoli and strawberries, started sending vast quantities of fertiliser-laden runoff into the slough in the 1950s. “Elkhorn Slough has some of the highest nutrient concentrations ever recorded on planet Earth,” says Hughes. This nutrient overload fuelled explosive algal growth

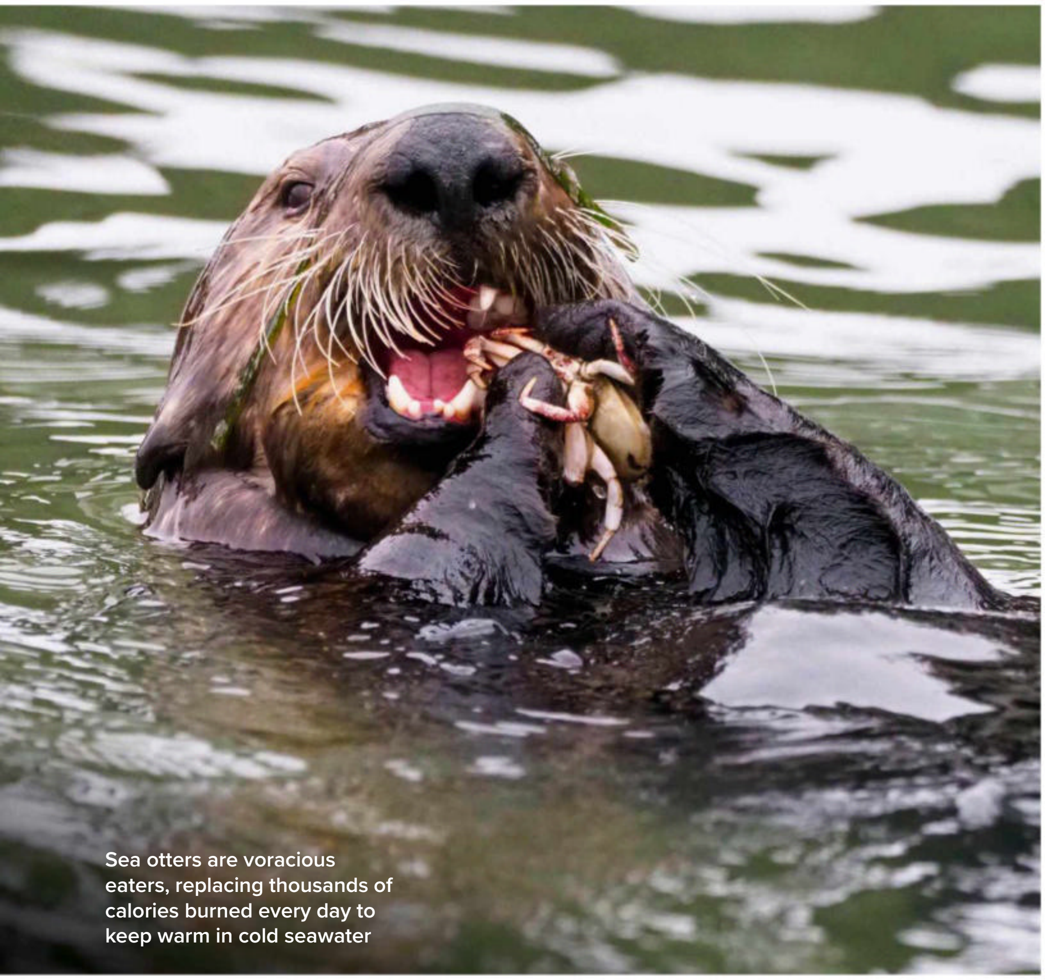
ABOUT THE AUTHOR

Ryan Wagner is a wildlife biologist, photographer and science journalist. He is currently pursuing a PhD at Washington State University.



Where is Elkhorn Slough?

The estuary lies on the central coast of California, about 30km north of Monterey. It is one of the largest estuaries in the state, spanning about 680ha.



Sea otters are voracious eaters, replacing thousands of calories burned every day to keep warm in cold seawater

Sea otters bask among seagrass, a rich habitat for prey such as crabs

"Elkhorn Slough began to disintegrate. Between 1956 and 2003, more than half the estuary eroded away"

that smothered seagrass beds and triggered a cascade of ecological decline.

Crabs, which thrived in the altered habitat, feasted on the small grazing invertebrates that normally keep algae in check. Their burrowing also destabilised the marsh banks, accelerating erosion. Elkhorn Slough began to disintegrate. Between 1956 and 2003, more than half the estuary eroded away. Land managers were desperate for solutions but nothing seemed to work.

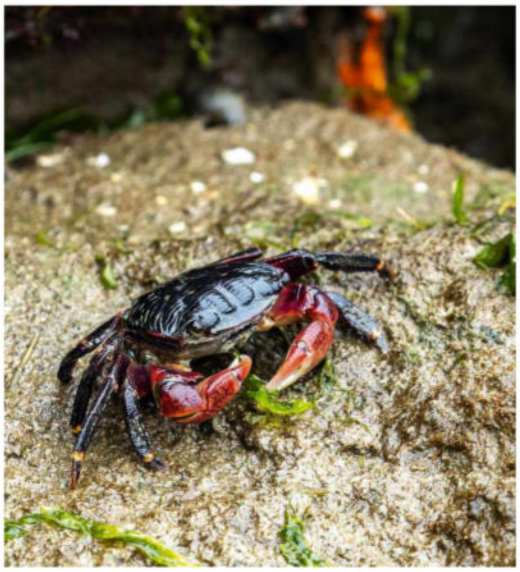
Then, something remarkable happened. In the mid-1980s, the nearly extinct seagrass began to return. Within three decades, it had increased sixfold. Elkhorn Slough was recovering but no one knew why.

The seagrass recovery defied conventional wisdom. Pollution levels remained high and no natural climatic event, such as El Niño, could explain the resurgence. It wasn't until Hughes got his hands on an unlikely dataset that the mystery was finally unravelled. No one could have foreseen that the solution was sea otters.

The ability of North America's smallest marine mammal to transform an ecosystem might seem surprising but it is well-documented in kelp forests.

In the kelp's case, the primary threat is sea urchins. These spiny, bottom-dwelling invertebrates troll the ocean floor on hundreds of tiny tube-feet, vacuuming up kelp. With their dexterous paws, sea otters are adept urchin-hunters. Floating on their backs and using stone tools as leverage, each sea otter can crack open 1,000 sea urchins in a single day.

By preventing urchins from over-consuming kelp, otters allow the entire ecosystem to flourish, creating what scientists call a trophic cascade.



The native striped shore crab is one of the most common species found in the slough

If left unchecked by predators, sea urchins can wipe out kelp forests

Sea otters are uniquely adapted to their coastal environment. Unlike other marine mammals, they lack a layer of insulating blubber, instead relying on a prodigious metabolism to stay warm in the frigid Pacific, consuming up to 25 per cent of their bodyweight per day. Their dense, plush coats – the thickest fur in the animal kingdom, with more than a million hairs per square inch – help them to retain heat but also made them a prime target for 18th-century fur trappers.

By 1910, unregulated hunting had reduced sea otter populations from an estimated 250,000 individuals to fewer than 2,000. Though hunting bans and conservation efforts saved them from extinction, California's current population of 3,000 otters occupies just a fraction of their historic range. Most live in offshore kelp forests but, in the 1980s, a small group of males ventured into Elkhorn Slough.

OTTER EATING: ROBERT HARDING/ALAMY; OTTER GROUP AND CRAB: LUCIANE COLETTI; URCHINS: RUSSELL LAMAN/NATUREPL.COM

Floating families

Sea otters have a flexible skeleton, short forepaws and are well adapted to a life spent floating. They often float on their backs, using their abdomens as a 'table' for prey and as a platform for their young pups. Females give birth to a single pup, with peak pupping season in California between January and March. Youngsters depend on their mothers for about six months. Males provide no parental care.

Otter pups' fur is so thick that it traps air inside it, leaving them unable to dive underwater

PhD student Kathryn Beheshti (*left*) measures marshland vegetation cover with assistant Alexandra Thomsen

"The calm waters, abundant food and absence of predators made the slough an appealing refuge"

At first, scientists regarded this as a curiosity. Estuaries such as Elkhorn Slough seemed an unusual habitat for sea otters. But from the otters' perspective, the calm waters, abundant food and absence of predators, including orcas and great white sharks, made the slough an appealing refuge.

In the early 2000s, scientists from the Monterey Bay Aquarium began reintroducing orphaned otters into Elkhorn Slough as part of a bold experiment. One stormy Thanksgiving night, biologist Teri Nicholson and her team received an urgent call: a stranded sea otter pup had been spotted along the shore. Despite scouring the coastline for hours, they couldn't locate the pup's mother.

That same night, a female otter at the aquarium had given birth to a stillborn pup. Mother otters sometimes adopt orphans in the wild, so Nicholson decided to introduce the crying pup to the female. At first, the female seemed hesitant, sniffing the pup before retreating. "She seemed to indicate, no, you're not my pup," says Nicholson. But as the pup's cries continued, the female approached again. This time, she picked up the pup and cradled it. "She never put him down after that," says Nicholson.

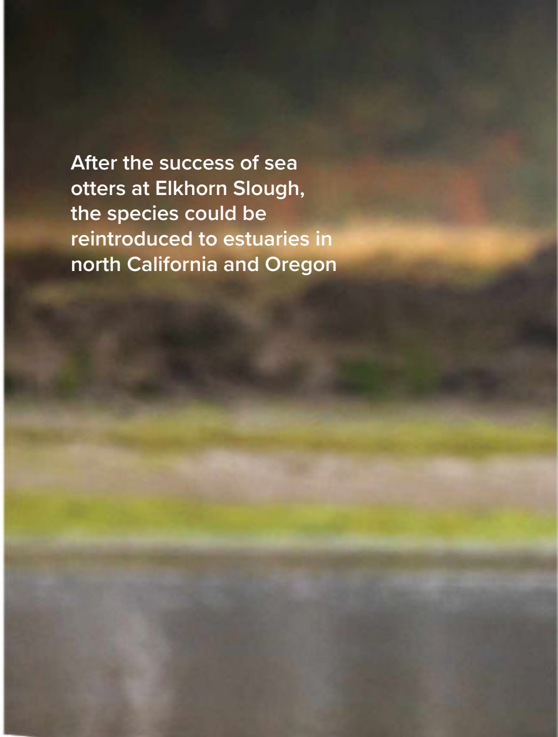
The pair formed a strong bond but the captive female's poor health made releasing them together impossible. So Nicholson released the pup into the slough alone, unsure if he would survive. Can a pup raised in a tank adapt to life in the wild, she wondered.

The pup stayed in the slough for three days. When his radio collar began pinging several miles off the coast, Nicholson feared the worst. She dispatched a rescue team but, to her amazement, the pup had integrated with a raft of wild otters in the northern reach of Monterey Bay. Despite his artificial upbringing, he was behaving like a wild otter. Years later, he returned to Elkhorn Slough as an adult, sired dozens of pups and lived for another decade.

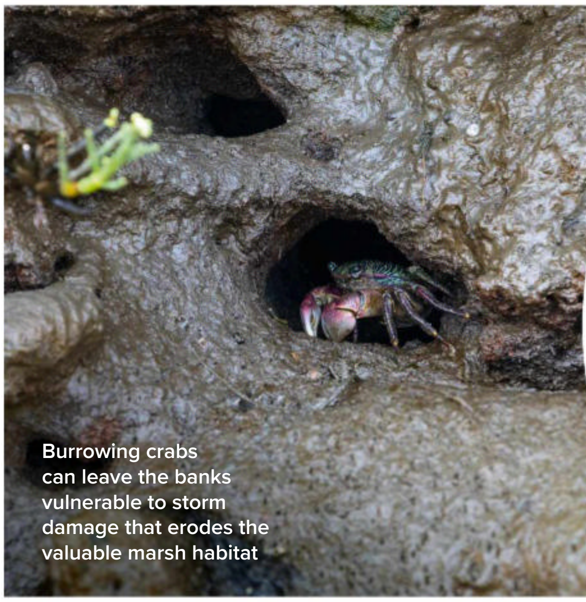
The American avocet is one of 340 resident and migratory bird species at Elkhorn Slough

OTTER WITH PUP AND RESEARCHERS AT WORK: LUCIANE COLETTI; AMERICAN AVOCET: SUZI ESZTERHAS/MINDEN/NATUREPL.COM

Kathryn counts crab burrows inside an area deliberately protected from sea otters



After the success of sea otters at Elkhorn Slough, the species could be reintroduced to estuaries in north California and Oregon



Burrowing crabs can leave the banks vulnerable to storm damage that erodes the valuable marsh habitat

Typical plants of the marsh include pickleweed (right, known as marsh samphire in the UK)

Today, Elkhorn Slough boasts the highest concentration of sea otters in California, with 60 per cent of the population released as surrogate-reared pups by the Monterey Bay Aquarium. Recent fossil evidence suggests that estuaries were once a major part of the sea otters' range, and their return to Elkhorn Slough hinted at a hidden role in the ecosystem.

When Hughes began studying seagrass in Elkhorn Slough, he paid little attention to top predators such as sea otters, instead focusing on the bottom-up effects of nutrients and plant productivity on the health of the estuary. The first clue that sea otters might be affecting seagrass was lucky. While Hughes and his team kept tabs on seagrass, a tour boat captain named Yohn Gideon was keeping tabs on otters. Every day for 15 years, starting in 2000, Gideon asked his passengers to tally the number of sea otters they saw during the tour. When Hughes overlaid this data with his records of seagrass abundance, the connection was unmistakable. "They fit like a glove," says Hughes. "Sea otters go up, seagrass goes up. Sea otters go down, seagrass goes down." But just what were sea otters doing, and what did it mean for Elkhorn Slough?

ON MISTY SPRING MORNINGS in 2013, then-PhD student Kathryn Beheshti would scan the still waters of Elkhorn Slough with a pair of binoculars. "Sometimes you would find 10, 15, even 20 otters rafting together," she says. "You could see harbour seals hauled out, sometimes a sealion or leopard shark swimming by. It was the most biodiverse place I have ever been." She pauses, and adds, "And you'd also see lots and lots and lots of crabs."

Like sea urchins, hyper-abundant crabs can have profound effects on their habitat. "Their burrows turn the banks into Swiss cheese," says Beheshti. "Metres of marsh can be lost in a storm, and that's marsh that's lost forever." Unlike kelp-eating urchins, crabs don't eat much seagrass. They prey on grazing invertebrates such as sea slugs, which normally keep algae in check. Without grazers, algae smothers seagrass, blocking sunlight and stalling photosynthesis. The result is a slow collapse of the ecosystem.

Could sea otters indirectly protect seagrass by eating crabs, Beheshti and Hughes wondered. To test this hypothesis, they placed cages around plots of seagrass to exclude foraging otters. Inside the cages, crab populations flourished, seagrass declined and erosion increased. In open plots where otters could forage freely, seagrass thrived. "Otters just move in and

CRAB COUNTING, BURROWING CRAB, PICKLE WEED AND OTTERS: LUCIANE COLETTI

“Most ecologists focus on doom and gloom. It’s refreshing to find these bright spots”

keep house,” says Hughes. Their research described a never-before-documented trophic cascade and helped to solidify the sea otter’s keystone role in estuaries. By eating crabs, sea otters help to stabilise the very sediment the estuary is built upon.

The discovery of sea otters’ role in estuaries has implications far beyond Elkhorn Slough. Seagrass meadows and estuaries across the Pacific Coast face similar threats from pollution and erosion. Reintroducing sea otters could help stabilise these habitats, particularly in areas such as San Francisco Bay, which, according to recent research, could support up to 6,000 otters.

The US Fish and Wildlife Service is exploring plans to reintroduce sea otters across their historic range, from north of San Francisco to Oregon. “Where would you put them? That’s the million-dollar question,” says Hughes. “All signs point to estuaries.”

Sea otters alone can’t solve all of Elkhorn Slough’s problems. Agricultural runoff continues to pollute the estuary, and the ecosystem remains vulnerable. Still, the recovery of Elkhorn Slough offers a rare story of hope in conservation. It shows that even in the most degraded habitats, recovery is still possible. “Most ecologists focus on doom and gloom,” says Hughes. “It’s refreshing to find these bright spots.”

For those who have ventured into the murky waters of Elkhorn Slough, the beauty beneath the surface is undeniable. On rare clear days, divers can glimpse seagrass meadows stretching taller than a person. “It’s incredible,” says Beheshti. “Few people scuba dive in California seagrass meadows but it’s like discovering another world.”

Among the seagrass, sea otters dive and twirl, foraging on clams, urchins, abalone and, of course, crabs. As sea otters continue to reclaim their place in California’s estuaries, they remind us of nature’s resilience and the critical role of predators.

My friends, the owls

In the company of owls, Polly Atkin finds solace from debilitating illness

By **POLLY ATKIN** *Illustration by* **CLAIRE HARRUP**

It is mid-May and I am sitting on a fallen tree in a wood, alone, squinting into the fast-fading light. Midges are nipping at my face and hairline. I want to pull up my hood to stop them biting my scalp but I don't want to cover my ears. Under the cover of the beeches and oaks it is almost entirely dark now, a kind of false, early tree-night.

I am waiting for owlets. Tawny owlets. I am sure that if I wait just a few minutes longer, I will hear their strange, raspy call – skeee skeee skeee – to tell me where they are. I know they are here, somewhere in the trees, because my partner and I have been watching them on and off for two weeks now, after a chance encounter one afternoon.

It seems foolish to be sitting out here letting midges feast on me, in the hope of making myself a mild annoyance to some other living creatures in turn, and I'm getting tired. Soon, I won't be able to see my footing on the way home.

Earlier, ambling up the road by twilight, I had passed a couple drinking wine outside their holiday home and overheard them exclaim how strange it was for anyone to be walking at this hour. Not here, I thought, where it is entirely normal for people to walk at all times of day and night, seeking stars or dawn cloud inversions, northern lights or northern sunsets. But this evening I am the only human in this wood.

I have been fascinated with owls since childhood. Growing up in suburban Nottingham, we occasionally had a tawny owl roosting in the tall trees around our 1950s house that were the remnants of much earlier, grander gardens. When I first moved to Grasmere in the Lake District, I lived in an attic room and was delighted to find I could hear tawny owls calling at night when I lay there, tucked into the eaves.

Even so, I did not see one close-up until the summer solstice of 2017, when the long, midsummer light meant our evening walk coincided with the owl's hunt. Over the past few years, a compounding of coincidences has meant we see them often.

I am chronically ill, disabled by a pair of unrelated but overlapping systemic genetic conditions that both cause pain and fatigue, and come with an ever-growing entourage of co-morbidities. My symptoms often keep me up at night. Listening to the owls hooting around my cottage, it is comforting to know I am not alone in my wakefulness.

Though walking is helpful for the long-term management of some of my symptoms, it aggravates others. I take short, familiar

ABOUT THE AUTHOR

Polly is a writer and poet who lives in the Lake District. Her new book, *The Company of Owls* (Elliott & Thompson, £16.99), is out now.

> "There, midway on a long birch branch, is a little wavery splot of not-tree in the near dark: the glowing grey outline of a tawny owlet"

walks in places I know will bring variety to my day in the form of my non-human neighbours: herons and frogs in the tarn, red squirrels, deer, a rotating cast of songbirds.

ONCE I KNEW THIS COMMUNITY might include owls, my favourite route was fixed. And so it was that in May 2023 my partner and I happened to be making our usual circuit through the trees at the precise moment three tawny owlets were contemplating launching themselves into the wider world from the platform of their nestbox.

I have almost convinced myself to get up and leave when I hear it, faintly, further along the path, the lamenting cry of a hungry owlet. Skeee skeeeeeeee. "Will I ever be fed?" it seems to say. "Does no one care for me?" I care, of course, but I have no fresh voles to offer.

I follow the sound and scan the trees. There, midway on a long birch branch, is a little wavery splot of not-tree in the near dark: the glowing grey outline of a tawny owlet. This one is quiet as a stone, its head bobbing as it tries to work me out. In a neighbouring tree, its two siblings are shouting for their dinner, although by the time I spot them it is so dark that my eyes register them only as blurred patches of textured dark. If I hadn't known they were there, I could have walked right past them, never have imagined they were just feet away from me, blending into the night. They have moved deep into the wilds of the woody common, away from the path and human intrusion.

The next day is bright and dry, the cold wind less cold. I take an earlier walk while my partner is at work, hoping to see the owlets in better light now I have a sense of where they are. I can't see them from the path, though I think I can hear one further up the slope. I climb a little higher, above the spot I saw them last. Instead of an owlet, I startle a parent owl from a tall tree, and it leads me higher up the slope. Just as I lose the first adult in the canopy, its mate flies past, coming from the other direction and leading me even further away. I see what they are doing and I can't fault them for it. By the time I lose sight of both parents I am far from their vulnerable, grounded babies.

My partner and I return at dusk and find the owlets near where they were the night before, all three together. They are restless and fidgety, as they always seem to be when they are waiting for dinner, hopping from tree to tree, stretching their long white legs and their browning wings. The eldest casually spreads its wings and flies to a tree further up the hill. This is the first time we have seen any of them fly, rather than leap and flap.

IN THE TWILIGHT THE OWLETS LOOK so ghostly, so immaterial, until they move and phase from haze into solid bodies. It is as though they are moving through dimensions when they leap, in and out of this reality and another. I understand, when I see them like this, so uncannily not quite material, why they have been considered otherworldly.

Tawny owls have long been associated with death – with graveyards, and with all things sinister and spooky. The call of a tawny owl is often used in films and TV shows to indicate that a scene is taking place after dark. But, to me, there is nothing deathly or scary about these birds. They are chirpy, comical and endearing. Utterly lovable. The only haunting thing is our continued failure to perceive them, to hear them for what they are.

As spring rolls into summer, we lose sight of the owlets when the bracken grows too high for us to pass along the small paths that lead to where they have settled. At the end of August we spot one of them right on the edge of their childhood territory, almost indistinguishable from the adults, apart from a slight hazy, unfinished look.

“The male presents his partner with a home, which she rejects if it doesn’t meet her standards”

One of the first things I learned when I determined to find out more about tawny owls is that not that much is known about them. There is a prevailing belief that they are hard to observe and monitor, even though they are the most common owl in the UK, with estimates of anywhere between 20,000 and 50,000 breeding pairs.

Because they are so common, they are well-represented in wildlife sanctuaries and rescue centres and, indeed, in the homes of people who rescue ill and injured birds. There are even several memoirs written by people who have raised or rehabilitated a tawny owl. This may not be the same as observing one in the wild but such experiences can still tell us a lot about the species’ habits, routines and character.

Observing the tawny trio in the wild, I learned how they respond to and care for each other. I loved to see how the siblings protected each other as soon as they were able, and would snuggle up, preening each others’ feathers. They defied all my expectations.

I still have so much more to discover but this is what I have learned so far about tawny owls that has surprised me. They love to sunbathe, and there is evidence that they need sunlight to make vitamin D, just as we do. They like access to fresh water for bathing – which they do often, flapping their wings in the water and splashing it over their bodies. It helps shed their downy baby coats. All water is not good, though – rain limits their ability to hunt, as it does with barn owls.

Tawny owls mate for life but a mated pair do not live together all year round. Partners come together at nesting season, then live apart for months. Each time they reunite, the male presents his partner with a home he has prepared, which she rejects if it doesn’t meet her exacting standards. Their ensuing chicks are born blind, like kittens. For the first week or 10 days of their lives the mother rips up food with her beak and waves it over theirs so they can feel it.

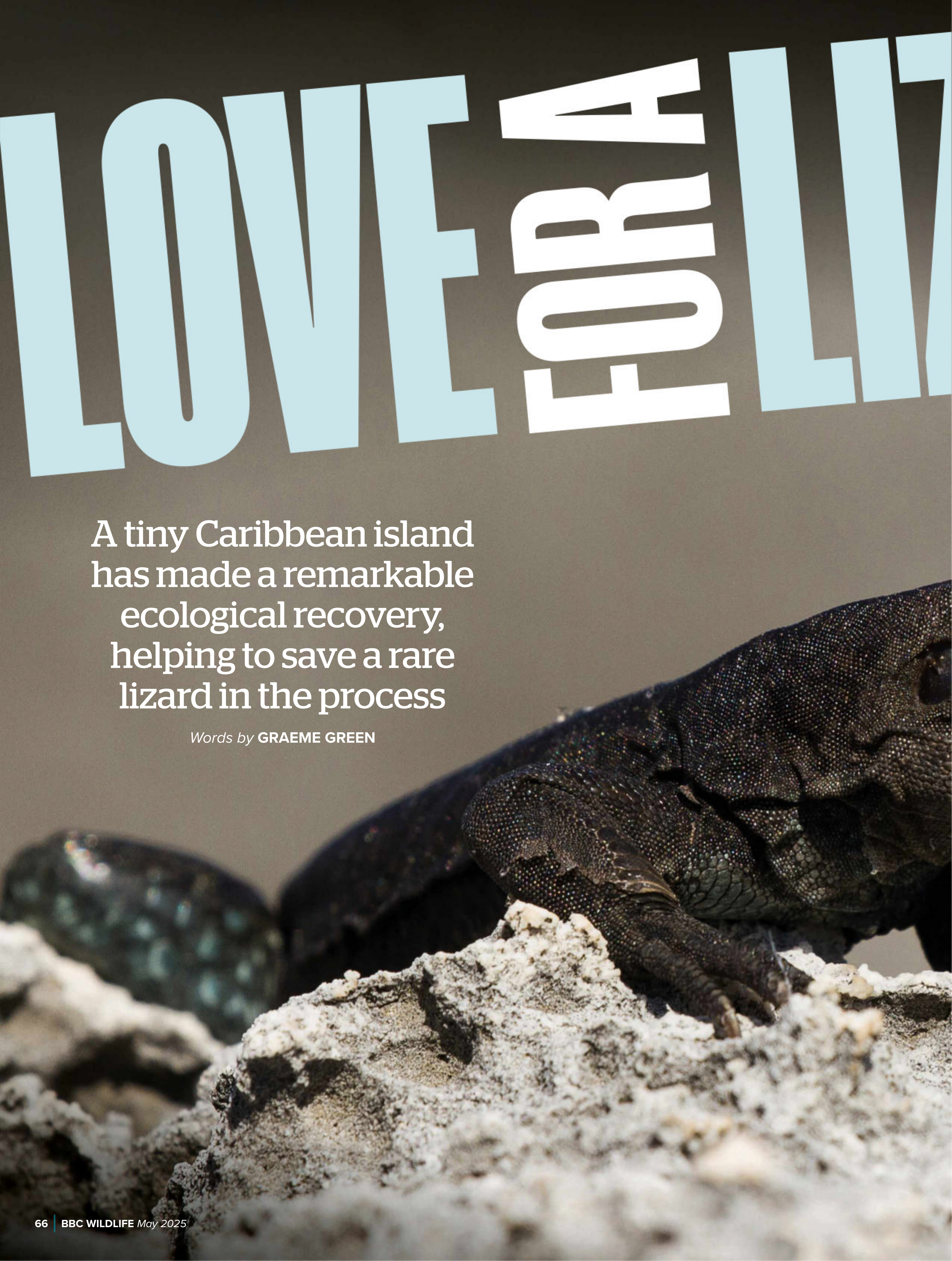
Owls have exceptionally large eyes, with an exceptionally large number of rods within them, which help form a high-resolution image in their brain. They cannot rotate them in their eye sockets like we can though, which is why they need to be able to turn their heads so far. The special construction of their eyes also makes them more sensitive to bright light and to light pollution – as they are to noise pollution with their acute hearing.

THERE ARE ALSO THINGS I have learned about myself because of learning about the owls. Like a tawny owl, I am a night creature that nonetheless loves the sun. I too relish a good bath, and am sensitive to light, noise and disturbance. I am deeply attached to my home territory, and I need to be alone as much as I need companionship.

Living with chronic illness can be a particular kind of loneliness, a separateness that, for me, was compounded by the pandemic. Spending time with the owls has made me feel less lonely, made me think again about different kinds of togetherness, different kinds of understanding.

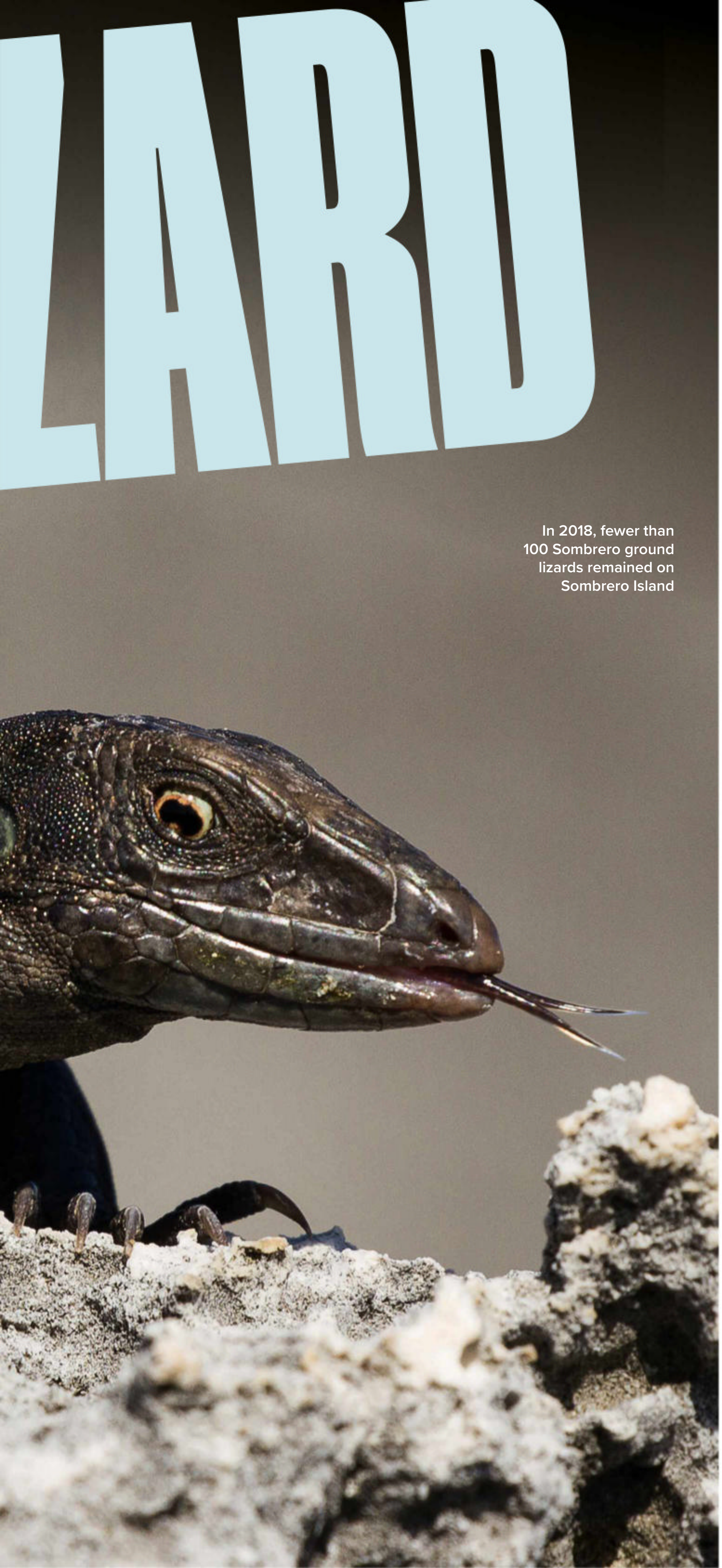
Living with energy-limiting illness and pain mediates my relationship with the natural world and with the landscape. I cannot always walk up the road to where the owls live, and I cannot stand or sit for very long watching for them. But I am so lucky that I get to see them so often – and even if I don’t, just to know they are out there, living their best owl lives, is enough.

LOVE FOR A LIZ



A tiny Caribbean island has made a remarkable ecological recovery, helping to save a rare lizard in the process

Words by **GRAEME GREEN**



In 2018, fewer than 100 Sombrero ground lizards remained on Sombrero Island

SOMBRERO GROUND LIZARD: TOBY ROSS/FAUNA & FLORA

At first glance, Sombrero Island doesn't look like a place where life thrives. The surface of this tiny, remote, windswept land mass, 54km north-west of the Caribbean island of Anguilla, has an austere, moon-like appearance, with white-grey rock, strewn rubble and gigantic craters that are an uncomfortable reminder of the phosphate mining that devastated and permanently altered its landscape.

The remains of the old lighthouse and other abandoned buildings are windowless, weathered and worn, giving the impression of a ghost island. There are no trees, and vegetation is scarce, with little soil for anything to grow. Indeed, Sombrero Island – which forms the heart of the Sombrero Island Nature Reserve Marine Park – was on the verge of total ecological collapse.

Look at a picture of the island now and it's a different story. Vegetation is returning and conservationists have recently celebrated a big win: a survey of the island's endemic and Critically Endangered Sombrero ground lizard has revealed that the population has rebounded to more than 1,600 individuals, from fewer than 100 in 2018.

"We are ecstatic," says Farah Mukhida, executive director at Anguilla National Trust. "These gorgeous little lizards have gone through so much. All the effort we've put into conservation has been worth it."

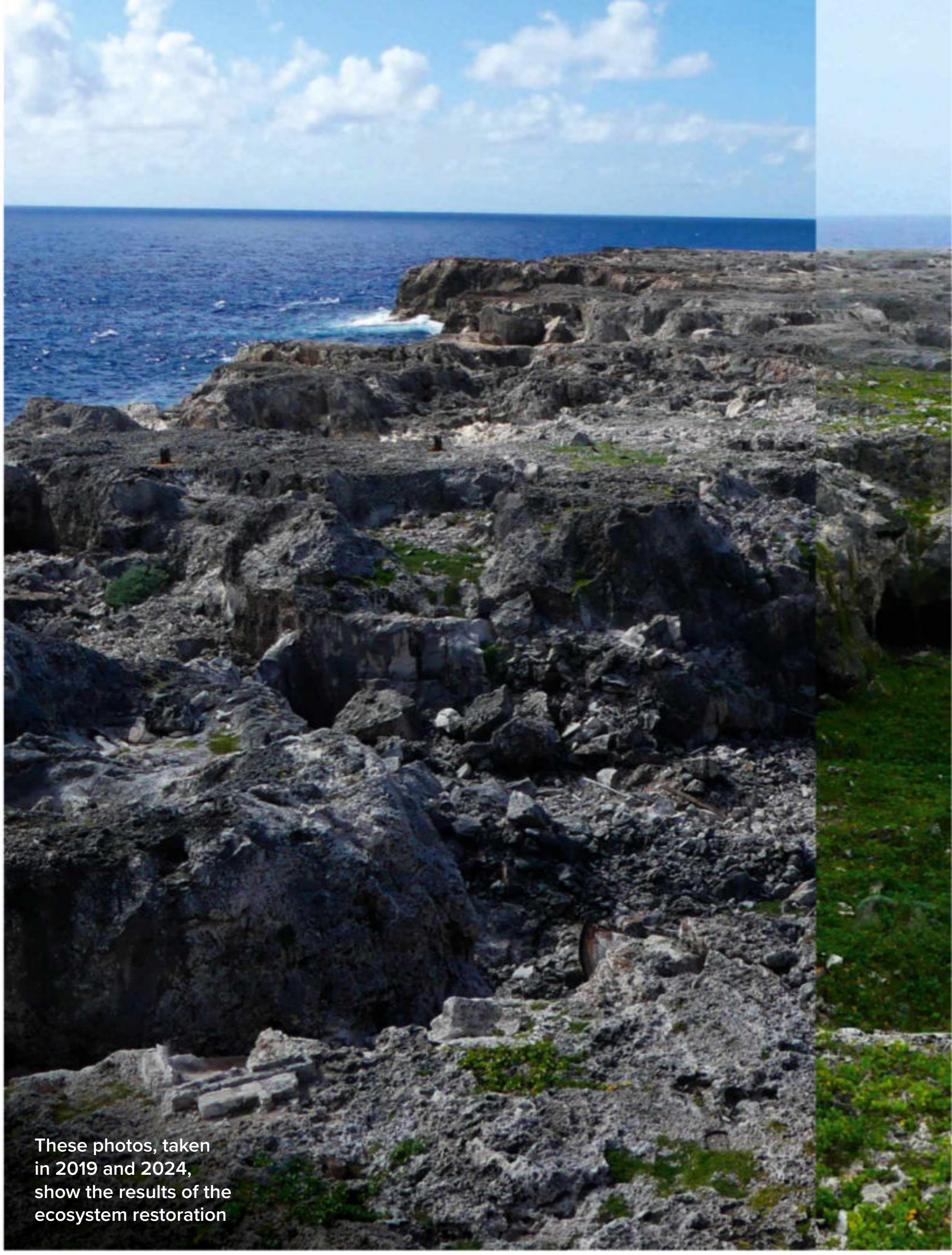
The Sombrero ground lizard's island home was once a natural paradise with abundant tree cover and enough vegetation to support its own endemic giant tortoise (*Chelonoidis sombrerensis*), plus a medley of other wildlife.

This diversity nosedived following the discovery of phosphate deposits on the island by a British geologist in 1811. For the remainder of the century, this small rocky outpost was heavily mined by the Americans and British. Up to 3,000 tonnes of phosphate

ABOUT THE AUTHOR

Graeme is a photographer and journalist. For more than 20 years, he's travelled the planet, reporting on stories for international newspapers and magazines.

Sombrero Island offers an important rest stop for migrating birds, such as this sandpiper



These photos, taken in 2019 and 2024, show the results of the ecosystem restoration

was harvested per year, much of it destined for use as fertiliser.

Christopher Columbus first set eyes on Sombrero during his second voyage (1493-96), and it’s thought the island was named by the sailors onboard due to the fact that, viewed from the side, it resembled a hat, with a long flat rim and a hump, or crown, in the middle. “That was destroyed when phosphate mining began, as the island was blasted out with dynamite,” says Mukhida. The ‘hat’ quickly crumpled and flattened, and the island became deforested.

The rapid degradation of habitat was compounded by the introduction of invasive species, particularly mice, which were brought to Sombrero via ships. Not only were the lizards having to cope in a radically altered landscape but they were also now faced with predators that voraciously took their eggs and young.

IF ALL THAT WASN’T ENOUGH, THE species has also had to contend with climate change, which has brought increased hurricanes, storms and giant waves that crash over the island, as well as exposure to longer periods of drought. “In 2018, there was a severe sea swell,” says Mukhida. “The island was in ruins. We thought that might be the end.”

How on earth did this little lizard manage to cling on in such a bleak, inhospitable outpost? “They’re very resilient little creatures,” says Mukhida. “Some vegetation survived, especially around the ruins of buildings, and that has really helped, as it attracts insects, which the lizards eat.”

The Sombrero ground lizard is found nowhere else on Earth. It measures around 15cm, including the tail. Its correct scientific name is *Pholidoscelis corvinus* but previously *Ameiva corvina* was used, from the Latin *corvinus*, meaning ‘raven’.

“The lizards look jet black from a distance, standing out like silhouettes on the white rocks of Sombrero, but their scales are tinged with blue,” says Jenny Daltry, Caribbean alliance director for international conservation organisations Fauna & Flora and Re:wild. “It would be hard to imagine the island without its miniature Komodo dragons. They usually keep a watchful distance from people until there’s food around, then they fall over one another in an unseemly scramble to gobble down as much as they can.”

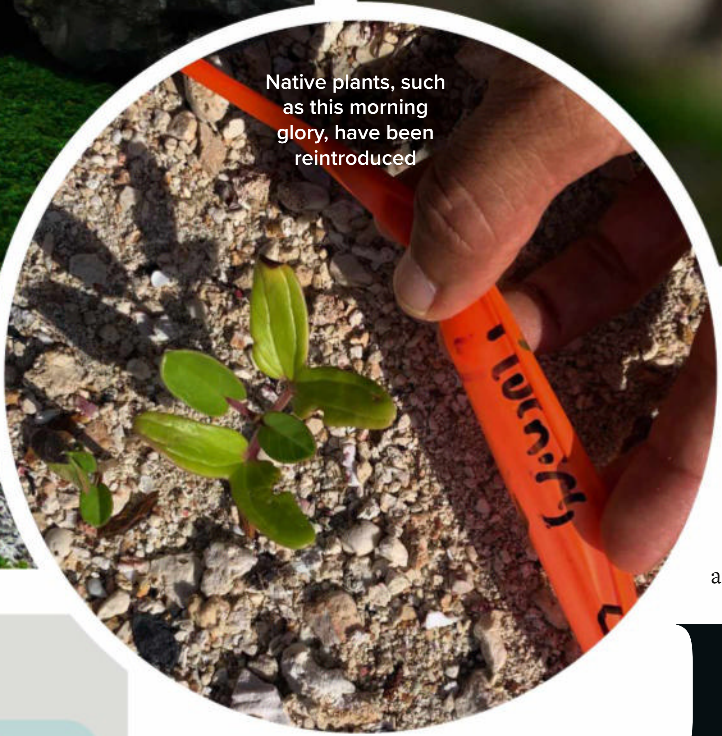
> “We’re giving not just lizards a better chance of survival but everything else that lives on Sombrero”

The lizards feed on almost anything from fruit to fish. Though they congregate around food, they are highly territorial. Males may share territories with several females but chase away smaller males, with juveniles usually exiled to the poorest corners of the island until they’re big enough to stake a claim to their own territory. Ground lizards don’t show any parental care: eggs are laid in warm soil and juveniles must fend for themselves after hatching.

Restoration work on Sombrero Island began in 2021. A team from the Anguilla National Trust, along with Fauna & Flora

SANDPIPER: TOBY ROSS/FAUNA & FLORA; BEFORE & AFTER: JENNY DALTRY/FAUNA & FLORA/RE:WILD

More than 1,600 of the lizards now inhabit the arid, limestone island



Native plants, such as this morning glory, have been reintroduced

and Re:wild, started to painstakingly 'regreen' the island with native plants such as sea bean, sea grape and prickly pear, and to eradicate non-native rodents using a grid of more than 1,000 bait points. "This was not an easy feat, on such a remote and rocky location," says Mukhida.

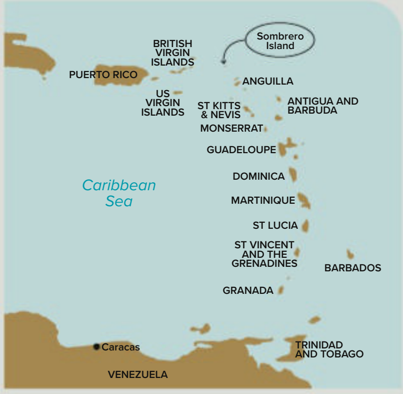
By the end of 2024, Sombrero was declared pest-free. In just three years, the island had become visibly greener, with the reintroduced plants already showing healthy growth. Biosecurity monitoring will remain in place to make sure rodents don't regain a foothold.

"We're giving not just the lizards a better chance of survival but everything else that lives on or visits Sombrero," says Mukhida. These include other rare and endemic species, including the Sombrero Island bee, the Sombrero Island dwarf gecko and the fearsome-looking, but harmless, Sombrero Island wind scorpion, plus several species of nesting seabird, such as the brown booby, masked booby, bridled tern and brown noddy.

Rewilding is a slow and painstaking process, and change won't happen overnight. Long-term, Mukhida hopes to see at least double the number of different plant species growing on the island. "Vegetation recovery would provide foraging habitat and shelter for the lizards, but will also encourage other species. It would be great to have more terrestrial birds, more insects and more biodiversity," she says.

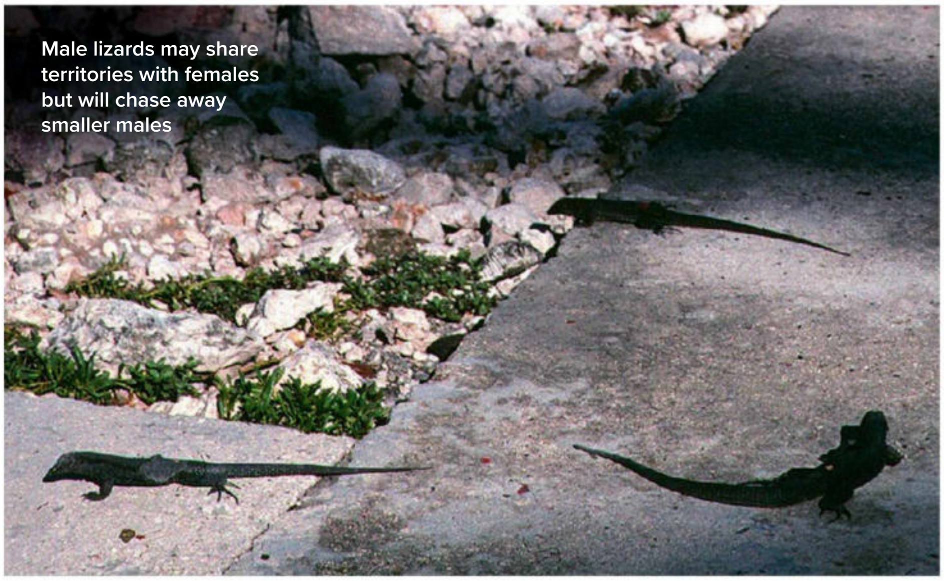
The dilapidated buildings may also be repaired, which means the island could host students and researchers from Anguilla and around the world, as well as "very bespoke, niche tourism" in future. "Sombrero is so beautiful and different from anywhere else around," says Mukhida. "Things would have to be done in a controlled, sensitive way, because we don't want to set back any of our successes."

Where is Sombrero Island?

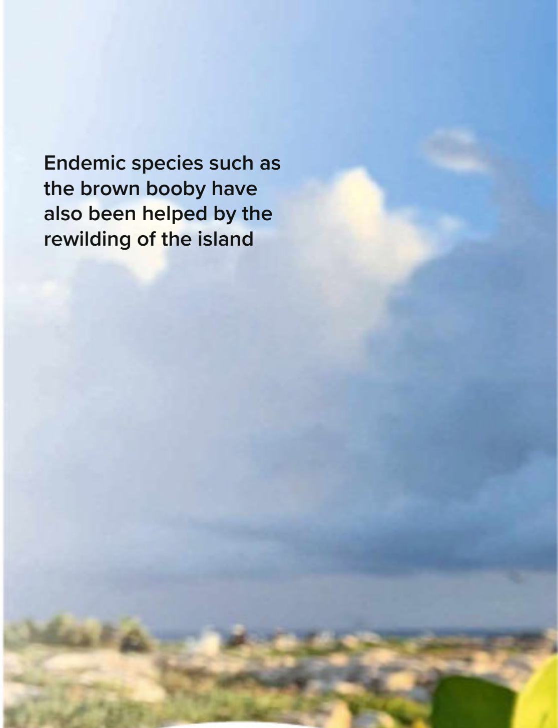

Sombrero Island
BRITISH VIRGIN ISLANDS
PUERTO RICO
ANGUILLA
US VIRGIN ISLANDS
ST KITTS & NEVIS
ANTIGUA AND BARBUDA
MONSERRAT
GUADELOUPE
DOMINICA
Caribbean Sea
MARTINIQUE
ST LUCIA
ST VINCENT AND THE GRENADINES
BARBADOS
GRANADA
Caracas
TRINIDAD AND TOBAGO
VENEZUELA

This Caribbean island, which has a total area of just 38ha, is the northernmost island of the Lesser Antilles and part of the British Overseas Territory of Anguilla.

SOMBRERO GROUND LIZARD: JUSTIN SPRINGER/RE:WILD; PLANT: FARAH MUKHIDA/ANGUILLA NATIONAL TRUST



Male lizards may share territories with females but will chase away smaller males



Endemic species such as the brown booby have also been helped by the rewilding of the island

The great southern white butterfly is one of the many species to benefit from the improved ecosystem

Conservationists conduct seabird surveys on the island

The lizards have an important role to play in the natural balance of Sombrero. As well providing a food source for species higher up the food chain, they offer pollination and pest-control services and clean up the carcasses of dead chicks and other waste from local seabird colonies. “But restoring the species is also about Anguilla’s wild heritage,” says Mukhida. “Anguilla’s offshore islands are biodiversity hotspots.”

Sombrero isn’t the first site in Anguilla to be turned around. Anguilla National Trust, Fauna & Flora and other partners have worked on six other locations in the past 12 years, including Dog Island, East Cay and Mid Cay, East Prickly Pear and West Prickly Pear, and Fountain Cavern National Park. Other potential locations are now under consideration.

The Caribbean is one of the world’s most biodiverse areas, home to more than 10,000 species that occur nowhere else on the planet. Yet the region has also suffered some of the highest extinction rates in modern history. Caribbean islands represent just 0.16 per cent of the Earth’s land area but have accounted for 10 per cent of the world’s bird extinctions, 38 per cent of mammal extinctions and more than 65 per cent of reptile extinctions since 1600, with habitat loss, invasive species and climate change all key factors.

Around 40 Caribbean islands have been rewilded to date. Of these projects, 30 were co-led by Fauna & Flora, whose work started in the mid-1990s with efforts to secure the survival of what was then the world’s rarest known snake, the Antiguan racer, by removing invasive rats from Great Bird Island.

“As soon as we removed the rats in 1995, the snake population more than doubled and we were able to successfully reintroduce the species to several more islands,” says Daltry. “To our amazement, Great Bird Island exploded back to life and became full of birds, insects and plants. It was a beautiful lesson and an inspiration to rewild more islands.”

THREE LIZARDS: JENNY DALTRY/FAUNA & FLORA/RE:WILD; BUTTERFLY: FARAH MUKHIDA/ANGUILLA NATIONAL TRUST; CONSERVATIONISTS: FARAH MUKHIDA

BROWN BOOBY: FARAH MUKHIDA/ANGUILLA NATIONAL TRUST

> “There are more than 1,000 Caribbean species facing extinction, and we’re trying to help as many as we can”

More Caribbean restoration projects are in the pipeline, including on Jamaica’s Goat Islands and Great Tobago in the British Virgin Islands. “There are more than 1,000 Caribbean species facing extinction, and we’re trying to help as many as we can,” says Daltry.

Among those at highest risk, with fewer than 100 individuals left in the wild, are the mountain chicken (a gorgeous plump frog about the size of a guinea pig), the elegant Saint Lucia racer snake and the magnificent carossier palm of Haiti.

Other priorities are the keystone species that are especially important for creating and maintaining healthy ecosystems, such as native crocodiles, iguanas and sharks. “Seabirds deserve special attention, too,” adds Daltry, “because of how important they are for boosting the growth of mangroves and coral reefs, and increasing fish populations.”

Daltry is keen to see more education and training, especially for locals, so that there are “more people with the skills to restore ecosystems and wildlife populations,” as well as more support from private landowners and, crucially, additional funding. “Rewilding islands is not cheap but there is nothing more rewarding than seeing them come back to life,” she says.

“The work on Sombrero has been immensely beneficial and has enabled a remarkable turnaround for its charismatic lizard. But there are as many as 10,000 islands in this region, most of which have invasive rodents and other introduced pests. There is plenty more to do.”

Shipping lanes off Sri Lanka run straight through the feeding grounds of blue whales

SEA OF GIANTS

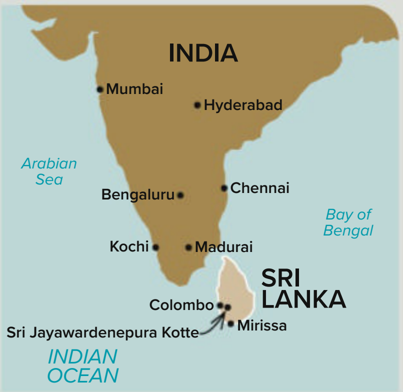
An unusual alliance is forming to save Sri Lanka's remarkable whales

Words by **TRISTAN BOVE**

WHALE AND SHIP: SBEDAUX/GETTY

OFF SRI LANKA’S southern coast, where the ocean drops into an indigo trench, a blue whale dives below the surf, her gargantuan size belying the grace of her movement through the silent water. Her hymn of clicks and whistles resonates through the deep, calling to her young calf.

Where is Sri Lanka?


INDIA
Mumbai
Hyderabad
Arabian Sea
Bengaluru
Chennai
Bay of Bengal
Kochi
Madurai
SRI LANKA
Colombo
Sri Jayawardenepura Kotte
Mirissa
INDIAN OCEAN

Perched off the south-eastern tip of India, Sri Lanka lies at a crossroads of maritime routes traversing the Indian Ocean. Numerous whale species live in the waters around the island.

Large-bodied whales such as blue whales are the cetaceans most frequently hit by ships

Both blue whales and container ships come close to Mirissa

Most dead blue whales sink without trace rather than washing onto beaches

Her kind has lived here for generations, at the pinnacle of a food chain that begins in the ocean's depths. But her world is different from that of her ancestors. Overhead, giants of another kind carve across the sea – ships, hundreds of them, their steel hulls an invisible threat. This female had grown accustomed to the ships' presence. But one spring morning proved to be her last.

In March 2012, the lifeless body of an 18m female blue whale was found in the harbour of Colombo, Sri Lanka's largest city, a deep gash exposing her left flank. She had collided with *The Quartz*, a container ship, and was discovered draped over its bulbous bow, a spear-like protrusion at the front of the vessel. Eyewitnesses reported no smell, suggesting she had died recently.

A team disposed of the corpse out at sea but, two days later, the remains washed up on a beach south of Colombo. The dead whale was now rapidly decomposing: its flesh had turned a putrefied grey, its carcass flecked with lacerations left behind as birds pecked through the carrion. This time, the smell was unmistakeable.

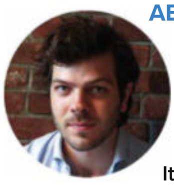
The case was later documented by Asha de Vos, a prominent marine biologist in Sri Lanka. The collision alerted conservationists to the dangers whales face in the seas surrounding the island nation.

A cosmopolitan species, most blue whales embark on seasonal migrations through every ocean except the Arctic, never staying put for long. But in the northern Indian Ocean around Sri Lanka, a remarkable confluence of meteorological and geological quirks enables these giants, plus a menagerie of other species, to thrive year-round.

Before calling into port in Colombo, *The Quartz*, like many vessels, traversed Sri Lanka's southern coastline. Since 1980, that stretch of water has hosted one of the world's most heavily trafficked shipping lanes, a funnel for maritime trade connecting Asia with the Arabian Sea, and onwards to the Middle East and Europe.

More than 100 merchant ships ply these waters daily. Over a decade after *The Quartz* struck that whale, I saw some of them from a vantage point on one of the beaches flanking Mirissa, an idyllic fishing village on the southern shore. They drifted across the horizon, almost peaceful despite their size. It was impossible to see the deadly obstacle

ABOUT THE AUTHOR



Tristan is a freelance science journalist specialising in climate change and economics. He has lived and worked in the USA, Italy and Hong Kong.

BLUE WHALE: ALEX MUSTARD/NATUREPL.COM; MIRISSA: CURIOSO PHOTOGRAPHY/ALAMY; DEAD WHALE: RANIL NANAYAKKARA

Bryde's whales can also be found off the coast of Sri Lanka

> "As technology has connected the seas like never before, new dangers are emerging for these gentle giants"

course beneath them, impossible to know of the graveyard of giants in their wake.

From the brainy sperm whale to the elegant Omura's and the inquisitive Bryde's, many whale species call the waters around Sri Lanka home. But none are more iconic than the island's blue whales.

THESE LEVIATHANS JOURNEY the world's oceans along seasonal migratory routes. In summer, they feed near plankton-rich poles and, when temperatures dip, they travel to warmer climates to breed and give birth. Most blue whales follow these patterns, save for those encumbered by age or malady. But Sri Lanka's families are peculiar, being among the few of their kind to stay close to home all year round.

"In the northern Indian Ocean, most blue whales are unusual and stay close to the equator," says Russell Leaper, a whale scientist at the International Fund for Animal Welfare, who has consulted on whale welfare in Sri Lanka for more than a decade. Their aversion to wanderlust, he explains, comes down to the waters around the island representing the whale version of an all-you-can-eat buffet.

A few kilometres south of Sri Lanka's coast, the seafloor plunges hundreds of metres deep. Here in the ocean's depths, a place almost no light can penetrate, decomposing organic matter accumulates in the form of nutrients such as nitrates and phosphates. This material might languish on the seafloor were it not for the powerful columns of water that regularly rocket it to the surface.

Between the island's two monsoon seasons, Sri Lanka is constantly buffeted by interchanging wind patterns. In summer, hot and humid air sweeps in from the Indian Ocean to the south. In winter, cool and dry winds from the Himalayas descend from the north. The contrasting air temperatures accelerate wind speeds and create perfect conditions for upwelling, the process that shifts warm surface water offshore and replaces it with cooler water from the deep sea.

These swirling currents ferry a smorgasbord of nutrients to the upper layers of the ocean, where tiny microorganisms consume them. Among these are krill – small, shrimp-like crustaceans and a staple food for blue whales. Floating near the surface, shimmering like dust caught in sunlight, krill in Sri Lanka have adapted

A group of sperm whales, the largest toothed whales, off Sri Lanka

Ship noise is also a threat to blue whales, which use sound to sense their environment

BRYDE'S WHALE: XINHUA/ALAMY; SPERM WHALES: TONY WU/ NATUREPL.COM; BLUE WHALE AND BOATS: RANIL NANAYAKKARA

to thrive in tropical seas thanks to the strong upwelling cycles, and blue whales are present year-round to gobble them up.

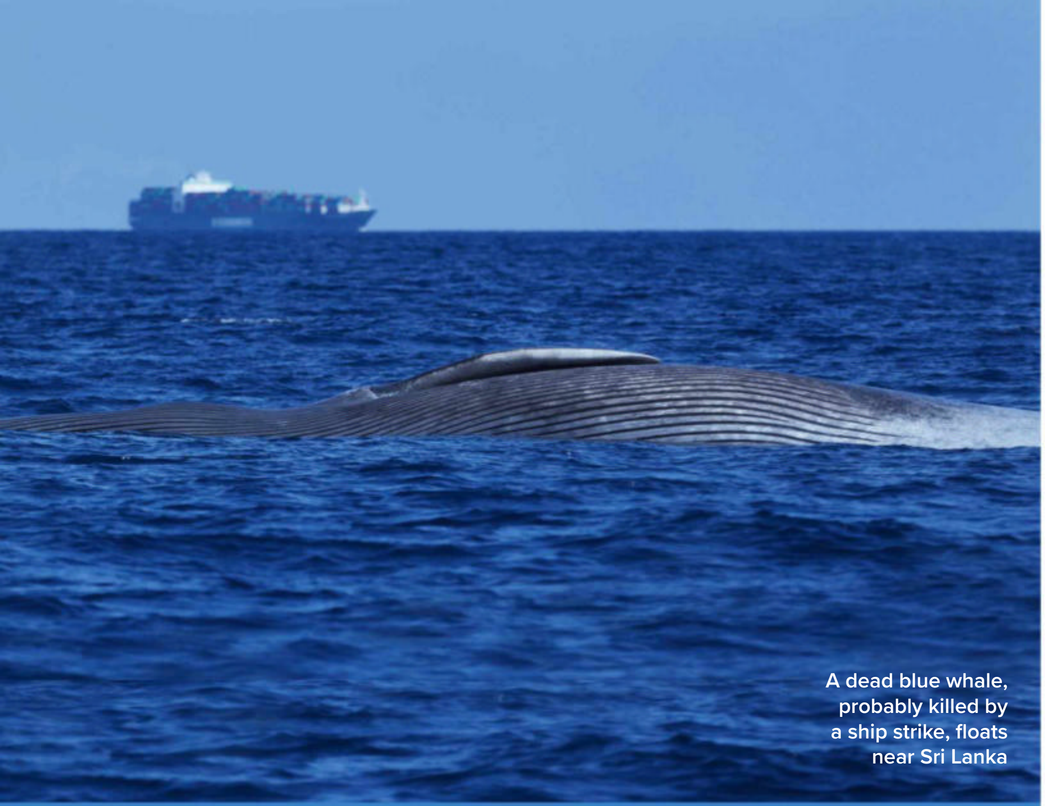
Few things threaten blue whales; humans are one of them. The spread of commercial whaling in the early 20th century destroyed global numbers from nearly 300,000 to a few hundred as whalers harvested the animal's blubber and oil for everything from lamp fuel to bars of soap. It took decades to regulate whaling and partially restore blue whale populations but, as technology and trade have connected the seas like never before, new dangers are emerging for these gentle giants.

"Generally speaking, collisions with ships and entanglement with fishing gear are now the leading human-induced threats to whales," says Anna Nisi, an ecologist at the University of Washington, whose research focuses on how animals navigate human-dominated areas.

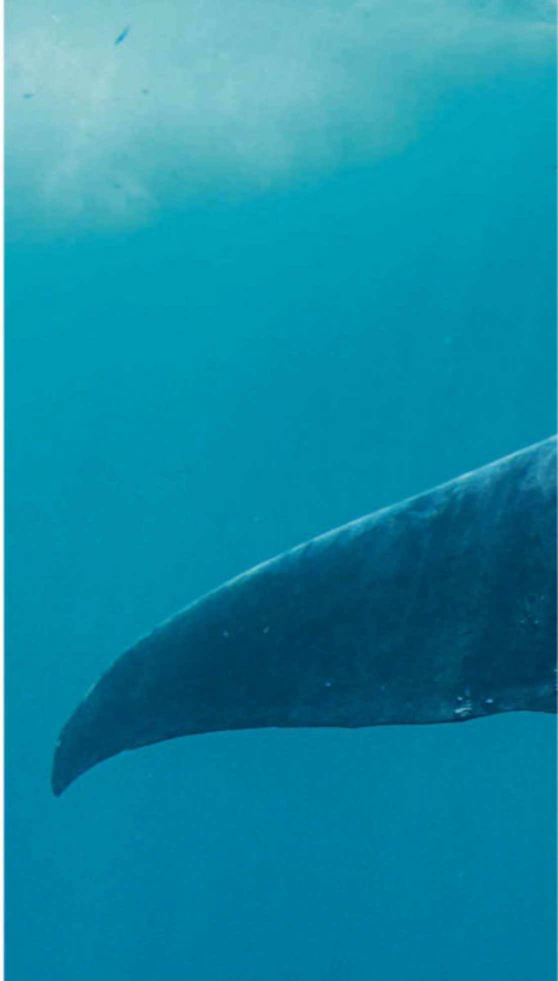
A 2024 study authored by Nisi produced the first model-mapping of where shipping traffic intersects with whale movements. She discovered that, while the ocean is no longer a whaler's hunting ground, it remains a battlefield: 92 per cent of known whale ranges overlap with shipping routes, now a 'primary threat' to the creatures. The northern Indian Ocean surrounding Sri Lanka ranked among the riskiest places for whales, particularly blues, to navigate.

Nisi's analysis relied on predictive modelling, using shipping and whale movement data to estimate where collisions are likely to occur. It cannot tell us exactly how many whales have been struck around Sri Lanka. But perhaps nothing can.

Beached whale carcasses, like the female that collided with *The Quartz*, are the exception rather than the rule. After only a few days, a deceased whale's remains lose buoyancy and sink to the seafloor, a phenomenon known as whale



A dead blue whale, probably killed by a ship strike, floats near Sri Lanka



A brief history of ships strikes

Before maritime transport was motorised, whales could easily outpace seafaring vessels, but modern ships pose a much greater risk. The first accidental whale collision was recorded in 1877 off the coast of Rhode Island, where a small whale became caught in the propeller of the *Munroe*, a steamship.

Documented collisions remained rare until commercial shipping surged in the 1950s, introducing heavier and faster vessels. Large oil tankers and cargo ships joined the fray in the 1970s, around the time global trade began coalescing around internationally sanctioned shipping lanes, many of which overlapped with whale migration paths.

It wasn't until the 1990s that scientists began aggressively tracking ship strikes through long-term studies. More recently, predictive modelling has helped researchers estimate where collisions are likely to happen, and some ships have adjusted speeds and routes accordingly. But because whale movements and shipping lanes transcend borders, international legislation has proved elusive.

fall. Condemned to the ocean's depths, the creature's flesh and skeleton create miniature ecosystems where other marine life can thrive. But to humans, whale fall only means a graveyard in the abyss. The untold numbers that lie there died silently and unseen, the reasons for their demise buried with them.

THE TRUE RATE OF SHIP strikes, and resultant mortality, is a black box of unknowns. Sri Lanka's reported share of injury or death-causing strikes might be only 20 to 30 per cent of the total, says Ranil Nanayakkara, a conservation biologist in Colombo, based on his 2017 survey of whale deaths. Fish stock assessments off the USA's west coast have put the rate of detection for blue whales colliding with ships even lower, at only 2 per cent.

For more than a decade, de Vos, Leaper and other conservationists have petitioned the Sri Lankan government to reroute ships from the current shipping lane, which stands 8-10km from the island's southern coast. In 2023, several bodies filed a proposal with the International Maritime Organization, a UN agency responsible for marine transport, advising a new lane 27km offshore. Research has found that this adjustment could cut collision risk by 95 per cent.

Under the proposal, vessels calling at ports would continue on the current route and ships transiting through Sri Lankan waters would take the new lane. While the share of ships docking changes throughout the year, it averages around 15 per cent, according to Leaper.

But to advocates' dismay, the Sri Lankan government rejected the proposal. In a statement, officials questioned the lack of data on whale collisions and argued that placing vessels further from navigational infrastructure and well-charted seabeds represented a safety concern. In 2019, authorities were wary of the potential economic impact a new lane would have on ports.

Colombo is a principal port on the Indian Ocean

A missing endorsement from the government means many legal, insurance and logistical hurdles to a new lane remain uncleared. But in an encouraging sign for Sri Lanka's whales, similar measures elsewhere have succeeded without a helping hand from government.

A simple truth is that companies don't want their ships to be running into whales,

DEAD BLUE WHALE: TONY WU/NATUREPL.COM; COLOMBO: RUBEN RAMOS/ALAMY; WHALE TAIL: FRANCO BANFI/NATUREPL.COM

The blue whales of Sri Lanka are among the few to stay in the same area year-round

“In 2022, the shipping company MSC began rerouting its vessels to journey further away from Sri Lanka’s shore”

says Sean Hastings, an officer with the USA’s National Oceanic and Atmospheric Administration. In 2014, Hastings founded Blue Whales and Blue Skies, an initiative that incentivises shipping companies to reduce speeds while transiting close to California’s coast, a popular migratory corridor for blue whales and a collision hotspot.

More than 50 companies have signed on to navigate more cautiously in these zones, which Hastings reckons has reduced whale-strike risk by nearly 60 per cent. Three years ago, the programme did away with financial incentives such as awards and lower docking fees, instead focusing exclusively on positive recognition for participating companies, a momentum-based strategy that Hastings says is responsible for rising compliance.

“Whales are the best messengers to tell this story,” he says. “Everyone, including ship captains, cares about whales.”

Hastings has worked with de Vos to explore how similar initiatives could work in Sri Lanka, where consensus is building even without the government’s help. In 2022, MSC, the world’s largest container shipping company, began rerouting its vessels to journey 27km from Sri Lanka’s shore. A few months later, Wallenius Wilhelmsen, another cargo giant, made the same call.

Since these announcements, a third of ships transiting south of Sri Lanka have opted to move further out to sea. That share rises to more than half when it comes to the largest and fastest ships, according to Leaper. More unilateral decisions from companies are likely in the coming years, he adds, possibly amounting to a “new traffic scheme by default”.

In the meantime, a unique family of blue whales will share their home with silent killers. An untold number will be struck. A few might wash ashore, their wounds a visceral testament for the world to see. But most will sink into the deep, their slow arcs never to breach the surface again. A haven for whales who chose never to leave the island may yet become their paradise lost.

Still, some will dive. They will duck below keels, twist around propeller blades and sing warnings to their kin when they detect ominous vibrations pulsing through the water. A mother will still guide her calf to the surface, threading pathways now lined with steel. For now, this sea is still her sanctuary, not yet her grave.

Q&A

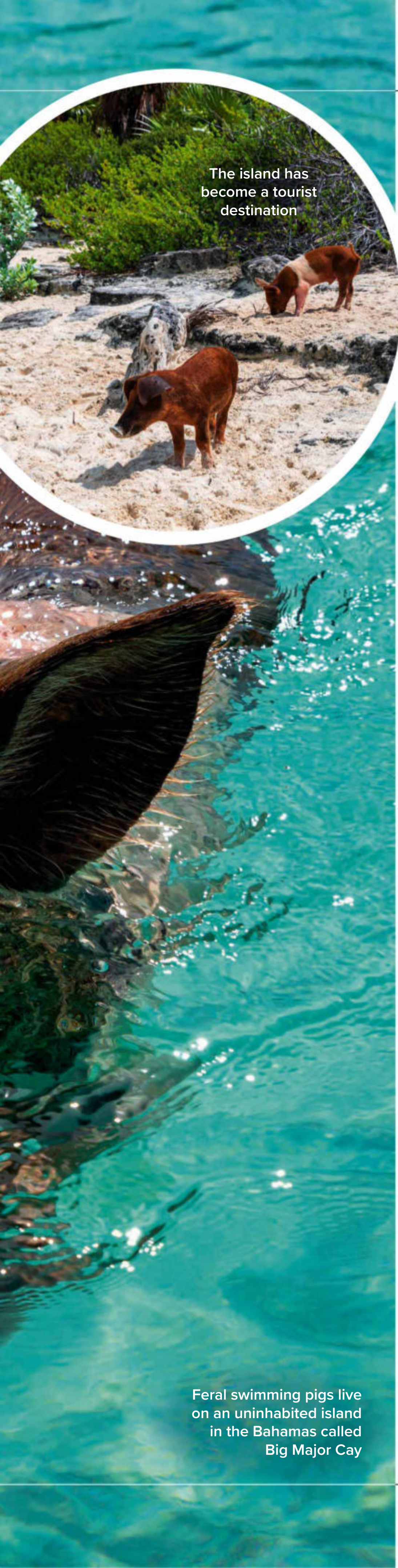
With Stuart Blackman
Email your questions to wildlifemagazine@ourmedia.co.uk

How did pigs get to Pig Island?

AN UNUSUAL WELCOME AWAITS VISITORS to Big Major Cay in the Bahamas. Moor your boat off the beach (which is the only way to reach this tiny, uninhabited island) and you are likely to be greeted by dozens of excited pigs bursting from the undergrowth and hurling themselves into the water before you can reach dry land.

These are not wild pigs but feral ones, and many a tale is told about how they got to Pig Island, as Big Major Cay has inevitably come to be known. One story goes that they are descended from animals stowed there by sailors of old, who never returned for them. Another is that they are the survivors of a shipwreck. A less swashbuckling (but more likely) scenario is that they've been here only since the 1990s, having been introduced by farmers from neighbouring islands.

The pigs have learned that tourists bring special treats, hence their eagerness to meet new arrivals. Meanwhile, more people are coming to swim with the pigs. But there are downsides to this newfound fame. The deaths of several animals have been linked to their ingesting large volumes of sand when people feed them on the beach.


The island has become a tourist destination

Feral swimming pigs live on an uninhabited island in the Bahamas called Big Major Cay

Carnivorous plants such as sundews use sticky traps

What is the stickiest substance?

MOST OF US COULD DO WITHOUT stickiness a lot of the time. Sure, it has its uses, and none of us would be here today if it wasn't for the various types of sticky mucus that lubricate, cleanse and protect our inner workings. But it quickly loses its charm when you're trying to find the end of the Sellotape after opening a jar of honey.

Stickiness is the product of the forces of adhesion (the attraction of different substances to each other, through chemical bonds, electrical charges or entanglement) and cohesion (the attraction between the particles of a single substance).

Some things are stickier than others. Dewdrops are sticky enough to hang off an orb web but they won't catch the spider any flies. Water scores high on cohesion and low on adhesion (which is why it forms drops on windows). An effective glue, too, needs to be cohesive, but it must also be, well, adhesive.

Nature came up with adhesives long before technology did. Indeed, the first postage stamp glue was made from the gum that oozes from wounds on acacias and other trees. Gum and similar substances, such as latex and resins, help defend the tree against herbivores by clogging their mouthparts or even engulfing them completely. It's no coincidence that amber, a gem as renowned for the perfectly preserved ancient life-forms it contains as for its beauty, is fossilised tree resin.

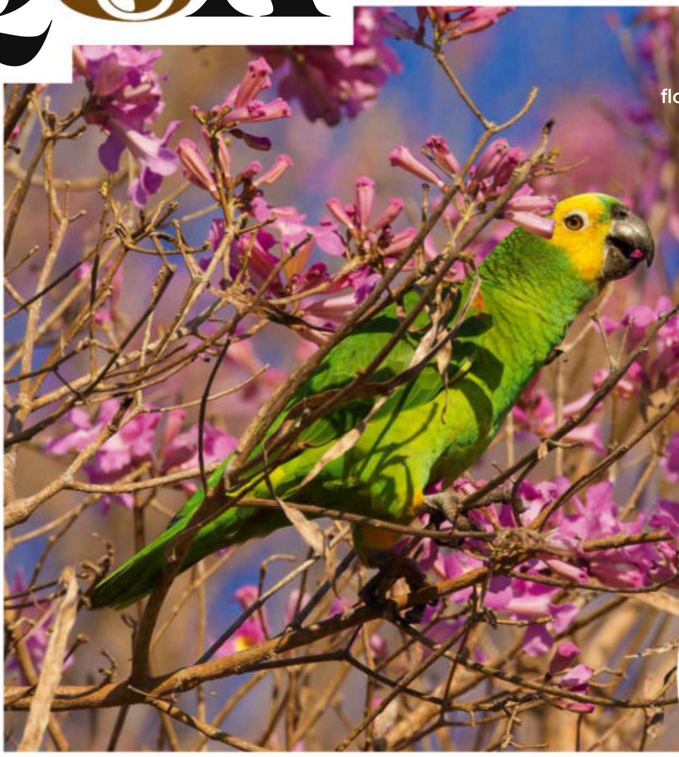
Stickiness is also deployed offensively. Vampire squids trail strings of tacky mucus behind them to catch food. Then there are the sticky traps of carnivorous plants such as sundews and, of course, spiders. Velvet worms, members of an ancient lineage of soft-bodied, millipede-like animals, entangle prey with a gelatinous fluid squirted at a distance from specialised mouthparts.

> "Vampire squids trail tacky mucus behind them to catch food"

Stickiness also has its uses in locomotion. The mucous trails of slugs and snails are sticky enough to adhere to overhanging surfaces but not so sticky that the molluscs are glued to the spot. Geckos cling to pretty much any surface at any angle, without any glue at all, instead relying on close contact with the surface by means of the nano-structure of their feet.

But the stickiest of all natural substances might be a glue produced by the freshwater bacterium *Caulobacter crescentus* to anchor itself to rocks. The scientists who discovered it in 2006 worked out that a 1cm^2 patch would be sufficient to suspend a 680kg weight – an average African buffalo, perhaps. But you'd need a very strong ceiling. And don't try it after handling honey.

PIGS (2): GIONGI63/ALAMY; ROUND-LEAVED SUNDEW: ALEX HYDE/NATUREPL.COM



Blue-fronted parrot feeding on *Tabebuia* flowers in Poconé, Brazil

The Amazon covers an area of 6m km^2

Which country has the most species?

IT’S ALWAYS GOOD TO REMIND OURSELVES how little we know. Or perhaps more optimistically, how much we still have to find out. The neuroscientist David Eagleman likens knowledge to a pier jutting out into a vast ocean of mystery and possibilities. No matter how long the pier, the horizon never gets any nearer.

It’s remarkable how much we still don’t know about the animals, plants, fungi and the rest that share our tiny corner of what might as well be an infinite universe (assuming just the one universe). We don’t even know how many species of them there are. It might be 2m or 20m. We do know that we’ve formally described fewer than 2m of them. (But we don’t know how many fewer because we don’t know how many species have been mistakenly described more than once.) Meanwhile, much more is known about some countries than others. Rich, northern countries have been more thoroughly surveyed than poor tropical ones, for instance. The upshot is that any attempt to answer this one is always going to be a bit back-of-the-envelope.

Since 2016, the environmental news organisation Mongabay has been giving it a good try by pulling together the data available for amphibians, birds, fish, mammals, reptiles and vascular plants (though it excludes invertebrates, which comprise the majority of animal species).

It might not be much of a surprise, blessed as it is with more than its fair share of Amazon rainforest, that Brazil comes out top. About 18 per cent of all described bird species are found within its borders, as are 14 per cent of amphibians, 7 per cent of mammals, 14 per cent of reptiles, 12 per cent of fish and 13 per cent of plants.

Part of the reason is its size. All else being equal, big countries will tend to rank higher just because they have more space. And Brazil is huge. Covering 8.5m km^2 of the world’s surface, it is the fifth biggest of all countries. Indeed, rank countries in terms of species number per unit area and Brazil doesn’t make the top 10.

But size isn’t everything. The two biggest countries, Russia and Canada, don’t even make it into the top 50 for overall species numbers. Seven of the top 10 countries (nine out of 10 when country-size is taken into account) are located in the tropics.

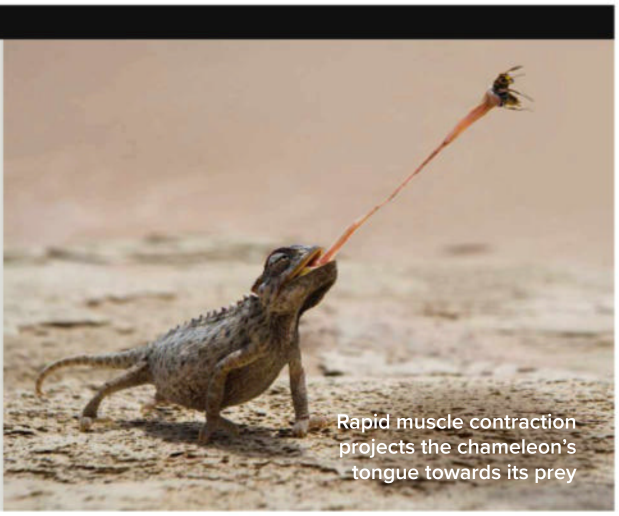
It’s known that biodiversity increases towards the Equator. The reasons for that aren’t entirely clear but it might have something to do with the tropics having been spared the ice ages that have intermittently scoured the life from higher latitudes, and the year-round high temperatures speeding up biological processes, including the creation of new species. Whatever the explanation, the sheer diversity of life in the tropics is, like the view from the end of a pier, as humbling as it is inspiring.

> “18 per cent of bird species can be found in Brazil”

RECORD BREAKER!

Which animal has the longest tongue?

As ever, it depends on what you’re measuring. At about the size of an elephant, a blue whale’s tongue, which is used to force huge mouthfuls of water through the baleen plates that filter out its food, is probably the longest in absolute terms. Relative to body size, though, it can’t match the chameleons. These predatory lizards can project the tips of their sticky, elastic tongues a distance of about one-and-a-half times their own body length to take out a fly. So it’s not entirely clear which of the two has this one licked. We could just say they are tongue-tied.



Rapid muscle contraction projects the chameleon’s tongue towards its prey

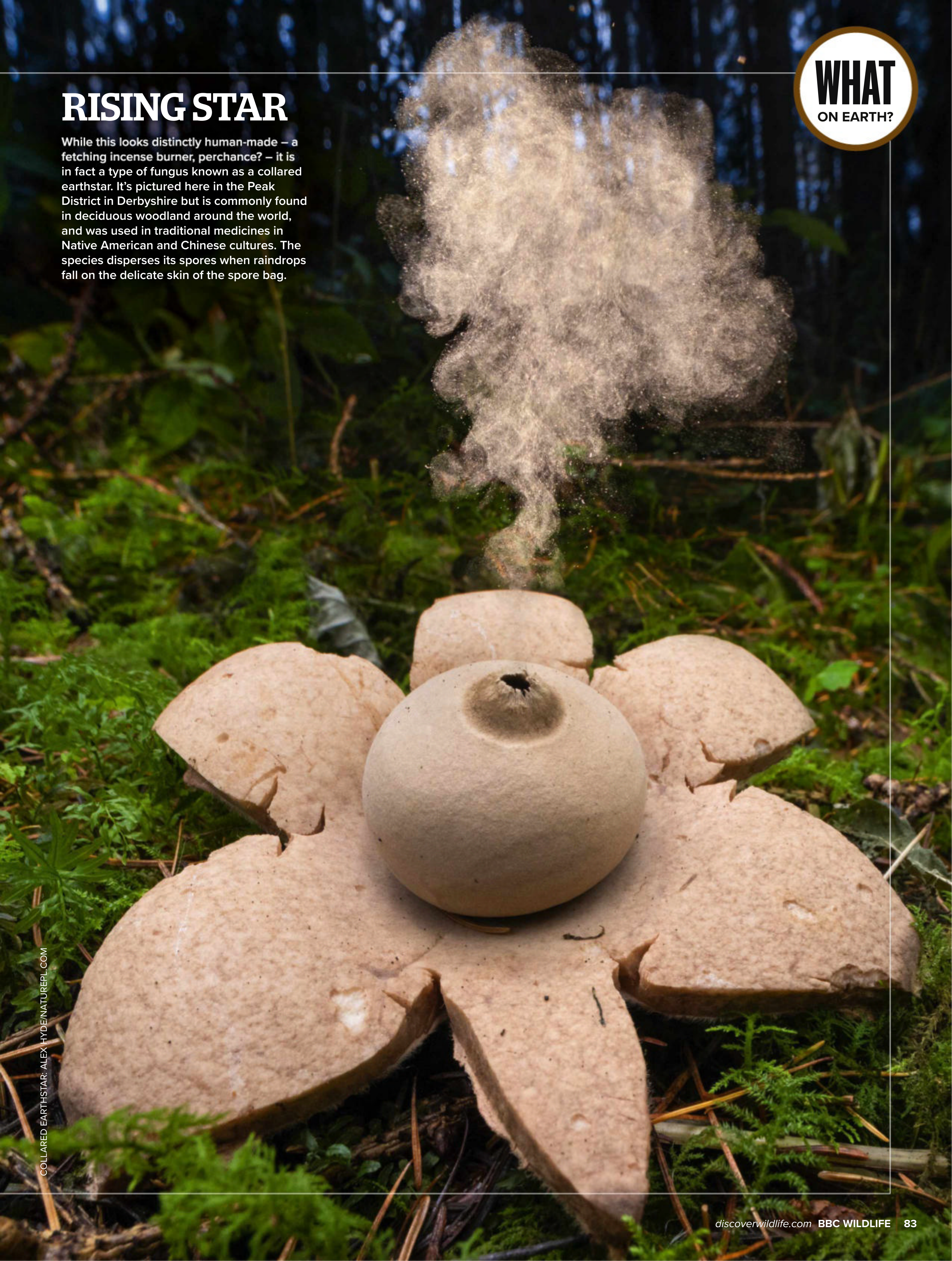
FACT.

Periodical cicadas have some of the longest life-cycles of any insect. They spend most of their time underground, with broods only emerging in the spring every 13 or 17 years.

PARROT: BRUCE THOMSON/NATUREPL.COM; AMAZON RAINFOREST: CURIOSO PHOTOGRAPHY/ALAMY; CHAMELEON: DIMITRI OTIS/GETTY

RISING STAR

While this looks distinctly human-made – a fetching incense burner, perchance? – it is in fact a type of fungus known as a collared earthstar. It's pictured here in the Peak District in Derbyshire but is commonly found in deciduous woodland around the world, and was used in traditional medicines in Native American and Chinese cultures. The species disperses its spores when raindrops fall on the delicate skin of the spore bag.



COLLARED EARTHSTAR: ALEX HYDE/NATUREPL.COM

The sound produced by the crustaceans is like oil crackling in a frying pan

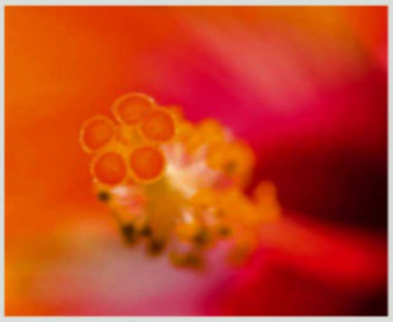
How do snapping shrimps snap?

YOU GET A LOT OF BANG FOR YOUR buck with a snapping shrimp. Just a few centimetres long, these little crustaceans (also known as pistol shrimps) use an enlarged front claw to produce a snapping sound about as loud as the clicks dolphins make to navigate in murky water.

It was long thought that the snap was the sound of the two fingers of the claw clacking together. But it's not that simple. One finger bears a plunger-like projection that fits snugly into a depression on the other when the claw snaps shut, forcing out a jet of water that is powerful enough to stun prey or kill it outright. The jet travels so quickly (about 90kph) that it leaves in its wake something like a vacuum, called a cavitation bubble.

The snapping sound is produced when the surrounding water pressure causes this bubble to collapse suddenly. So much energy is released in a fraction of a second that this collapse produces not only sound but also light and heat. Snapping shrimps also communicate with neighbours using snaps.

FAST ANSWERS



A hibiscus stigma, which collects pollen

What exactly is pollen?

Sexual reproduction involves the combining of genetic material from two parents (male and female) to produce offspring. In flowering plants, the female's genetic contribution is contained in a part of a flower called an ovule (which will become a seed once fertilised), and the male's in a pollen grain (produced by a flower's anthers). En masse, pollen appears as a fine, yellow dust. It is usually transported to the female parts of flowers on the wind or by pollinating insects in exchange for nectar.

What does panzootic mean?

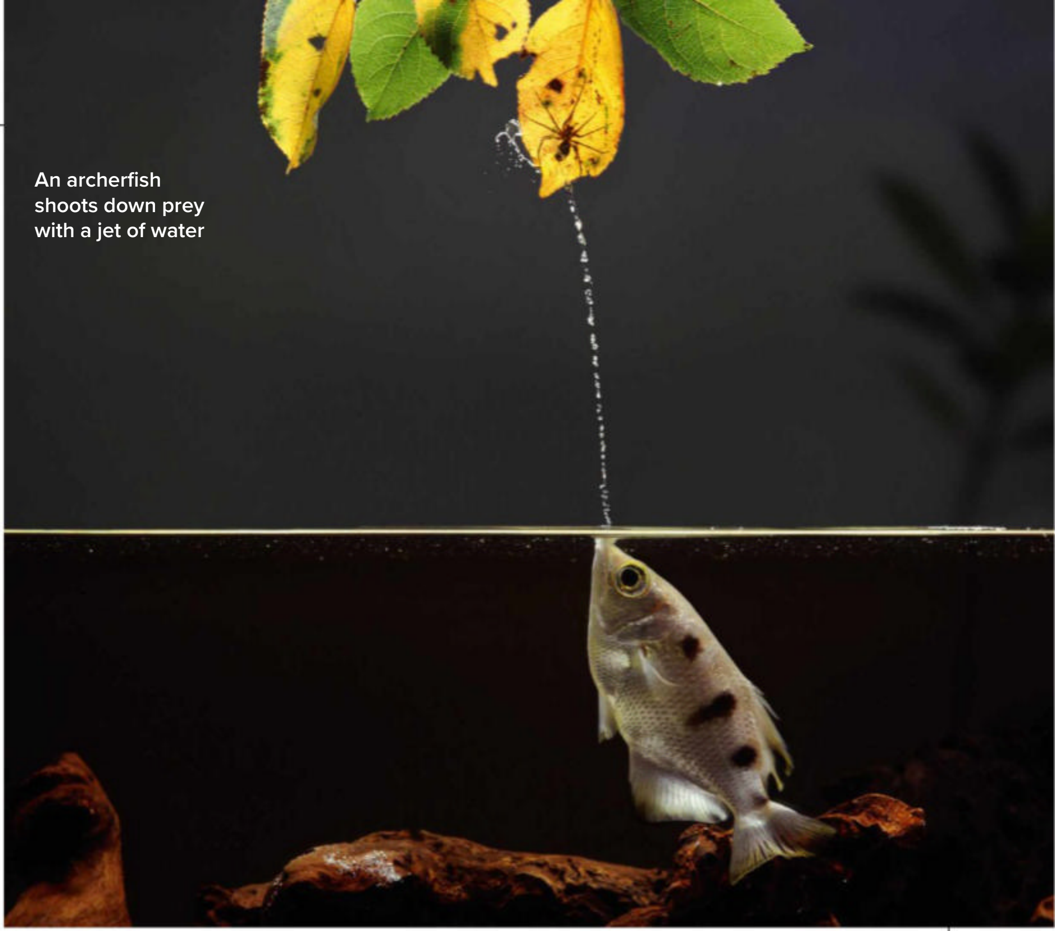
A panzootic is the animal equivalent of a pandemic: a disease that infects a high proportion of individuals across a wide area, such as a whole continent. It is a step up from an epizootic, in which the area affected is more limited. One example is avian influenza H5N1, or bird flu. Having originated in south-east Asia 20 years ago, it is now present on all continents, including Antarctica. H5N1 has also been transmitted to non-avian species such as pigs, bears and cattle, raising the possibility that this panzootic might yet become a pandemic.

Which fish look like rocks?

One of the camouflage options for fish living on the seabed is to look like a rock, the approach taken by various scorpionfish, frogfish and groupers. Perhaps the most celebrated is the reef stonefish, widely hailed as the world's most venomous fish, thanks to a row of venomous spines on its back.

Try not to step on a reef stonefish

SHRIMP: DAVID HALL/NATUREPL.COM; HIBISCUS FLOWER: JAMES SCHWABEL/ALAMY; REEF STONEFISH: ALEX MUSTARD/NATUREPL.COM


An archerfish shoots down prey with a jet of water

INSTANT EXPERT

How living things launch projectiles

WITH EVOLUTIONARY BIOLOGIST JV CHAMARY

SLOW AND STEADY WINS THE RACE, in nature at least, because speed often involves spending too much energy in a short amount of time. But some vital activities – such as capturing prey, defence and reproduction – do require sudden, explosive actions through ballistic movement.

What is ballistics?

You've probably heard the word on TV shows when police match bullets to a gun, but ballistics is actually the study of how any object – including a projectile launched by an animal, plant or fungus – is rapidly propelled by mechanical force.

What do animals fire?

Solid projectiles are typically body parts (very few species are able to launch foreign objects, such as spears thrown by humans). Though porcupines shooting quills is a myth, some animals can launch spines: Cnidaria, the diverse group of aquatic invertebrates that includes anemones, corals and jellyfish, have cells called cnidocytes that sting food or foes by firing needles laced with toxins.

Other animals shoot liquid, including bodily fluids that move along pipes and exit via nozzles: spitting cobras spray venom, for instance, while bombardier beetles eject hot, irritating chemicals. By contrast, archerfish hunt by firing shots of water to dislodge arthropods or even lizards from overhanging vegetation several metres away. The fish squeezes its gills to force water through a channel formed from an oddly-shaped tongue and a groove in the roof of its mouth, which creates a stream that becomes a bullet-like blob as it hits the target.

How are projectiles launched?

Ballistic movements are generated by storing force as elastic (potential) energy then releasing it as kinetic energy – like firing a rubber band by stretching it back then letting go. In animals, this is powered by muscle contraction and involves elastic fibres such as collagen.

But in plants and fungi, ballistic forces are typically powered by hydrostatic (turgor) pressure against the elastic walls of their cells. This is driven by osmosis, the movement of water in or out of cells so that they swell or shrink, often from absorption or evaporation. Releasing that pressure can launch projectiles, such as when squirting cucumbers explode and spread seeds in jets of slimy mucilage.

What do plants shoot?

Seeds, spores or pollen that carry reproductive cells. These future offspring are shot away from parents to reduce competition for resources, and may be eaten or catch the wind to be dispersed even further. A plant structure is often held in shape by water in its cells and deforms as hydrostatic pressure is released, moving any attached parts. For example, the fruit of hairy bittercress consist of turgid strips that, when dry, suddenly coil to catapult seeds away. This is explosive seed dispersal.

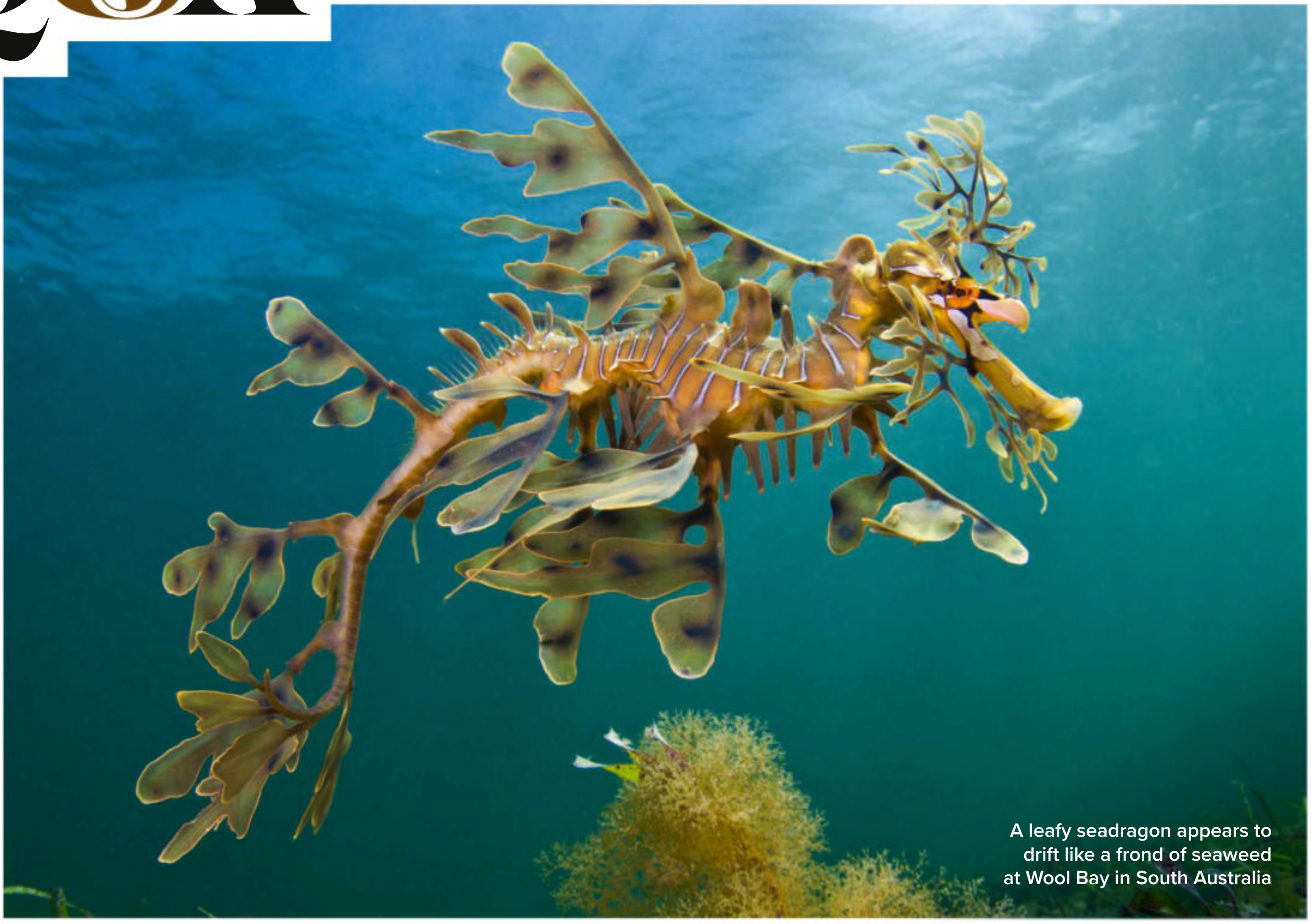
Shooting is challenging at microscopic scales as gas molecules become obstacles, which turns thin air into thick soup. To temporarily overcome drag, things must be shot at high velocity. In flowers of the white mulberry tree, filaments are held by threads that break when dry, causing a filament to spring outwards and fling the pollen it contains – like bowling a cricket ball – up to 6.6cm away at more than 600kph.

And what do fungi launch?

Like plants, fungi rely on ballistics for reproduction. The spores of most sac fungi (ascomycetes) shoot from the tip of pods, driven by pressurised sap. The other major group, club fungi (basidiomycetes), use condensation: each spore is attached by a peg and both collect water – when droplets merge, the centre of mass shifts and causes a spore to jump into the air. This transfer of momentum allows a mushroom to release as many as 30,000 spores per second, which equates to a total of billions over the lifetime of the fruiting body.

One unique case is the artillery fungus. Each of its 2mm-wide fruits rests on a cup whose surface flips from concave to convex, like the upward pop of a metal cap when you open a glass jar. This 'snap-through buckling' mechanism lets fungi propel fruits an astonishing distance of 6m, towards nearby plants and away from the 'zone of repugnance' that surrounds dung, making it more likely that a herbivore will swallow the fruits. The fungi pass through the gut and continue a reproductive cycle – nature's never-ending race.

ARCHERFISH: KIM TAYLOR/NATUREPL.COM (CAPTIVE)



A leafy seadragon appears to drift like a frond of seaweed at Wool Bay in South Australia

ALL YOU EVER NEEDED TO KNOW ABOUT

Leafy seadragons

BY JO PRICE

The official marine emblem of the state of South Australia is a creature that you might associate with myth, but leafy seadragons really do exist. They are less fearsome than their name would suggest – beautiful in shape and colour, they seemingly drift through the ocean. These bony fish are endemic to the coastal waters off south and east Australia and are hidden in plain sight – their camouflaging appendages give them a plant-like appearance. These unique and fascinating marine creatures suck up their food and, like seahorses, the males are responsible for childbearing.

What are their physical characteristics?

They may be fish but leafy seadragons don't have scales. Instead, their rigid bodies are covered with bony plates, with long spines along the sides of their bodies that may be used defensively. Their heads are small with long, thin snouts, and their eyes can move independently of one another. Their fins are transparent and their tails, which cannot be coiled, are about half their length. Leafy seadragons are usually yellowish to greenish-brown in colour.

How do they camouflage themselves?

The leaf-like appendages on the head, body and tail not only give these fish their common name but also enable them to resemble floating seaweed and blend into their habitat, protecting them from predators. Leafy seadragons are also able to change colour to match their surroundings.

How do they move?

Their movements also mimic the swaying motion of seaweed. They rely on a pair of pectoral fins and one dorsal fin to steer and move slowly through the water (they have lost their caudal and pelvic fins) and use their swim bladders to control buoyancy.

What do leafy seadragons eat?

The long, pipe-like snout and small mouth work like a pipette, allowing the fish to suck up mysid shrimps and sea lice. Other prey includes small crustaceans, plankton and larval fish. Leafy seadragons swallow their prey whole and do not have teeth or stomachs, so they eat continuously.

Where do they live?

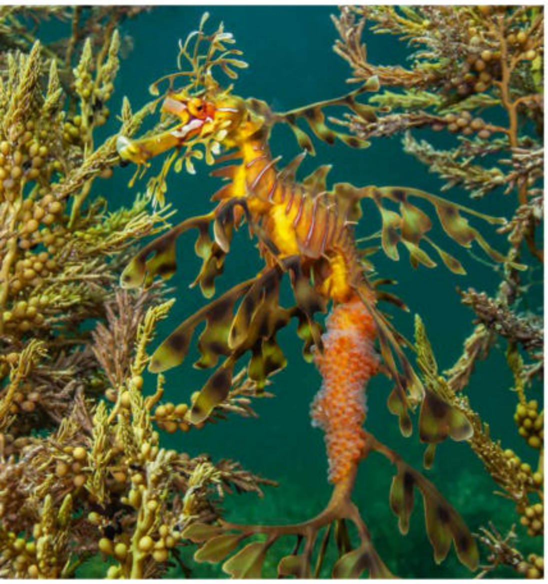
They inhabit the coastal waters of Australia, where temperatures fluctuate between 13°C and 19°C. These fish live among seagrass meadows, seaweed beds, rocky reefs and sand patches near weed-covered reefs, from the surface to depths of 30m.

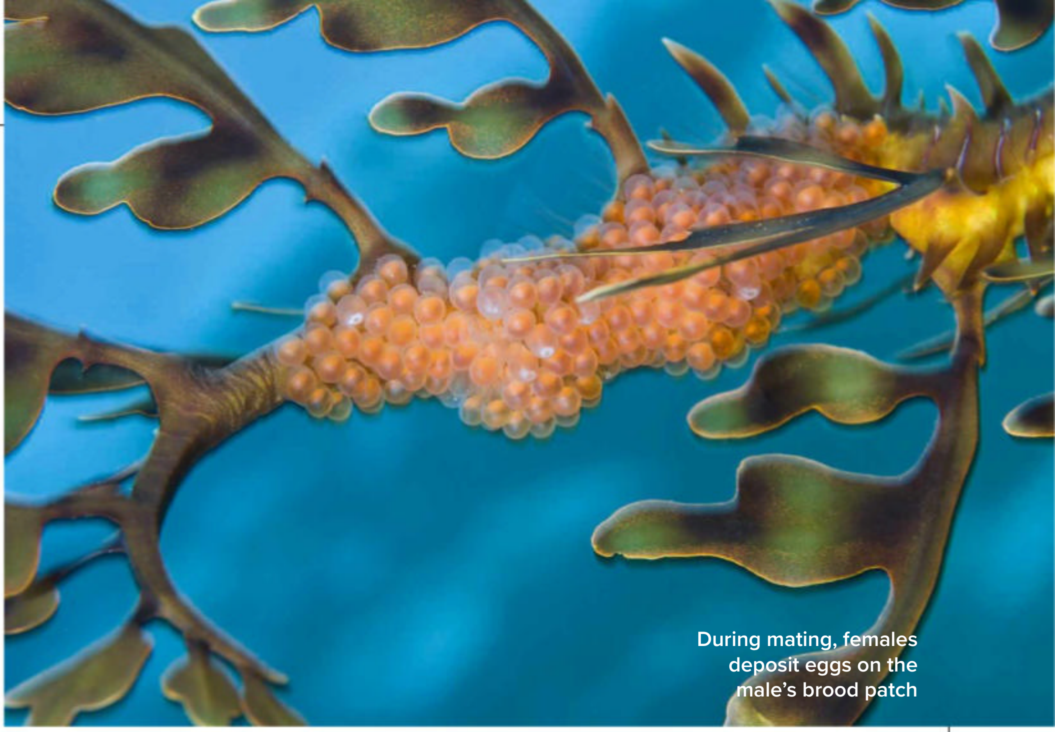
What is their lifespan?

Little is known about how long leafy seadragons can live in the wild but lifespan is estimated at between seven and 10 years.

How do leafy seadragons breed?

Male leafy seadragons become pregnant and give birth to live young. Unlike the pouch





During mating, females deposit eggs on the male's brood patch

Top: The seadragon's leaf-like growths make excellent camouflage among seaweed. Above: Mysid shrimps are a staple food

that seahorses have, a male leafy seadragon has a special brood patch on the underside of his tail, which develops as mating season (October to January) approaches. Here, the female deposits up to 250 eggs during mating. The eggs are fertilised during the transfer from the female to the male. The male incubates the eggs and keeps them secure, providing them with the necessary levels of oxygen. After about four to six weeks, miniature seadragons are gradually released into the water. During each breeding season, the male will usually hatch two batches of eggs.

How big are the young?

Baby leafy seadragons emerge from their egg capsule tail-first. They have a short snout, lack leafy appendages, and are silver and black in colour. As soon as a hatchling leaves the safety of its father's tail, it is independent. For the first two days, it lives off the still-attached egg capsule before it starts hunting. At birth, the young are about 2cm long, making them highly vulnerable to predators, with only one in 20 surviving to adulthood. However, they grow rapidly, reaching 20cm within a year and attaining their full length by the age of two.

How many species are there?

The leafy seadragon (*Phycodurus eques*) is one of three species of seadragon: the others are the weedy, or common, seadragon (*Phyllopteryx taeniolatus*) and the ruby seadragon (*Phyllopteryx dewysea*). Seadragons are relatives of seahorses and bony fish that belong to the family Sygnathidae (pipefish and relatives). All three species of seadragon are only found in Australian waters.

Do they face any threats?

They are illegally collected by people looking to keep them as pets. Pollution caused by excessive fertiliser run-off and ongoing coastal development, habitat loss and degradation, and being caught as bycatch has also caused their numbers to decline. Because they are inhabitants of temperate waters, seadragons may be impacted by an increase in water temperature due to climate change. According to the IUCN, the leafy seadragon and weedy seadragon populations are decreasing, and the ruby seadragon population is unknown (the species was only discovered in 2015). All three species are fully protected, along with all other sygnathids, by the Australian Environment Protection and Biodiversity Conservation Act 1999.

A LEAFY SEADRAGON'S SPECIAL FEATURES

AT A GLANCE

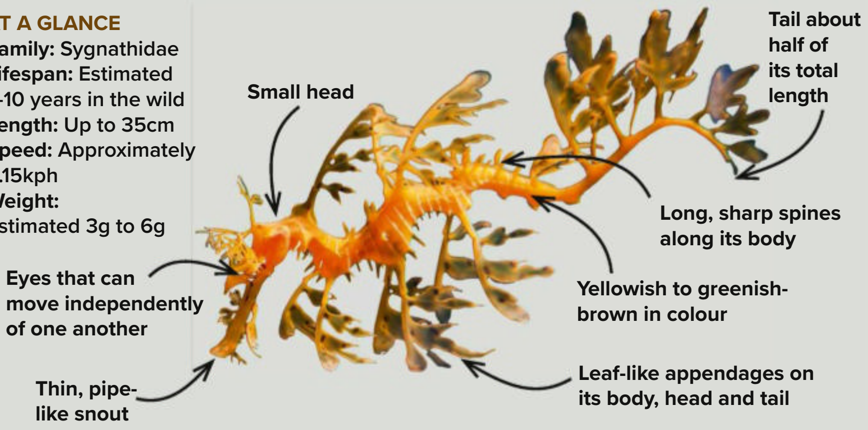
Family: Sygnathidae

Lifespan: Estimated 7-10 years in the wild

Length: Up to 35cm

Speed: Approximately 0.15kph

Weight: Estimated 3g to 6g

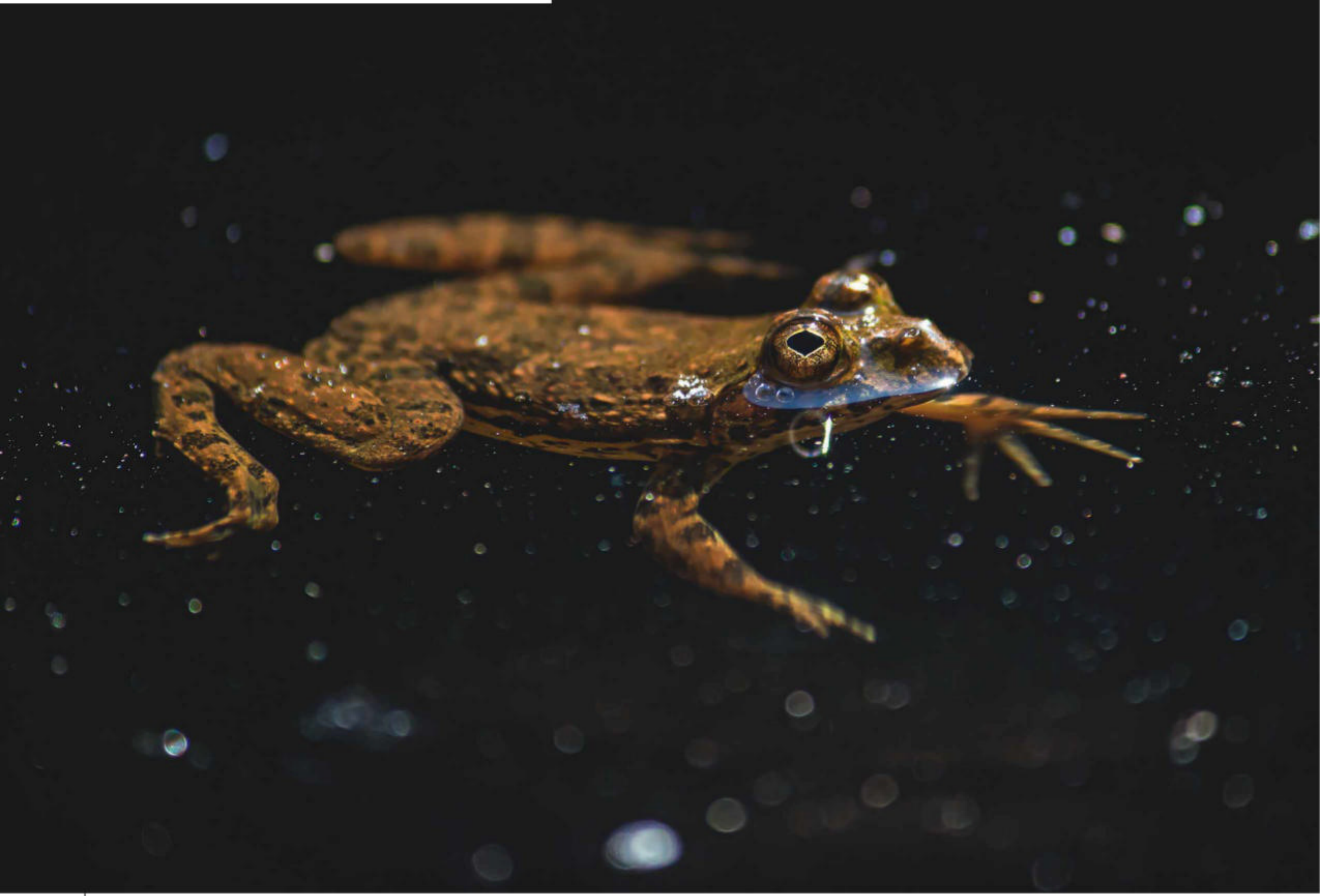

Small head
Tail about half of its total length
Long, sharp spines along its body
Eyes that can move independently of one another
Yellowish to greenish-brown in colour
Thin, pipe-like snout
Leaf-like appendages on its body, head and tail

NEXT MONTH

WALRUS

The toothy Arctic mammal

LEAFY SEADRAGON (MAIN IMAGE), CAMOUFLAGED LEAFY SEADRAGON, AND MALE TAIL WITH EGGS: ALEX MUSTARD/NATUREPL.COM; MYSID SHRIMP: DAVID FLEETHAM/ALAMY; CUTOUT: IMAGEBROKER.COM/ALAMY; ARCTIC WALRUS: ARIADNE VAN ZANDBERGEN/ALAMY

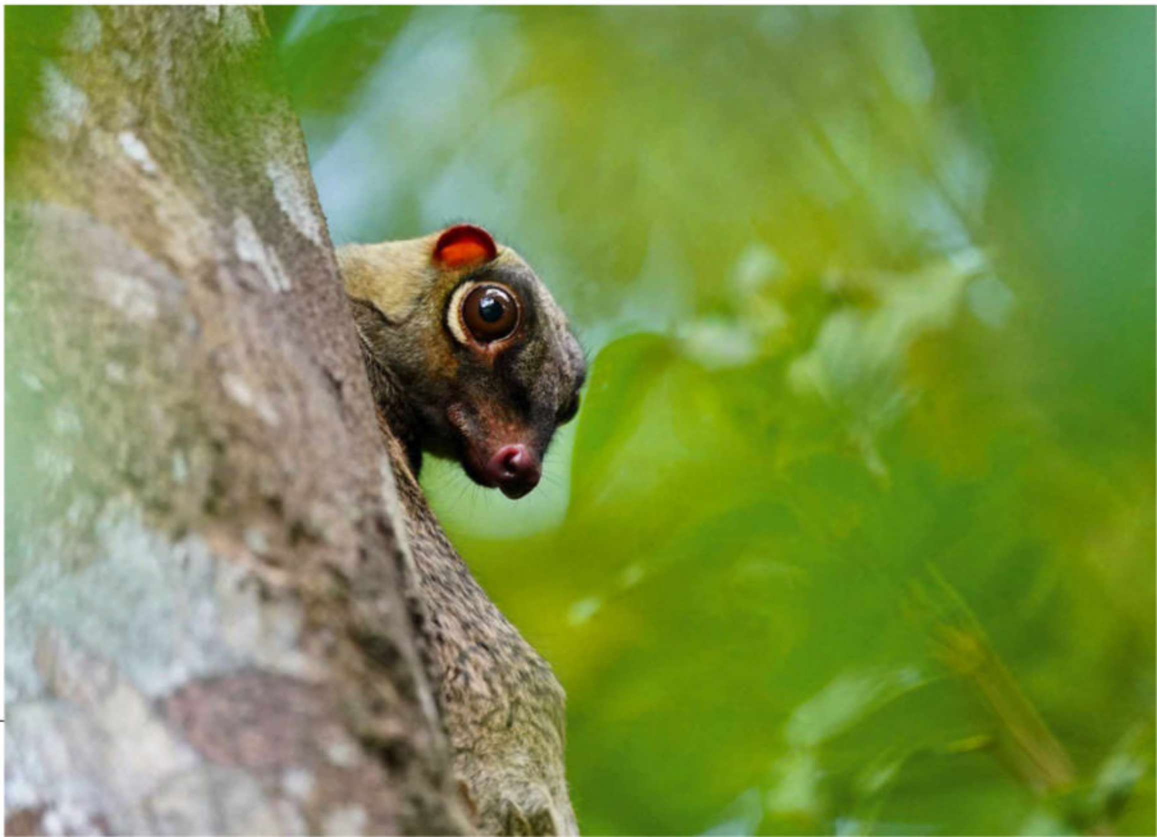


Floating stars

When I saw this common toad relaxing in water, I waited for hours for it to move to an area filled with light. I didn't expect the galaxy of 'bokeh' [artistic blurring] that surrounds it.
Harish Raghavan,
Tiruppur, India

A lucky look up

I was hiking around a nature reserve when I glanced up a tree and found this Sunda flying lemur halfway up the trunk, with its back facing me. Then it turned inquisitively to look at me.
Sean Nelson, Singapore



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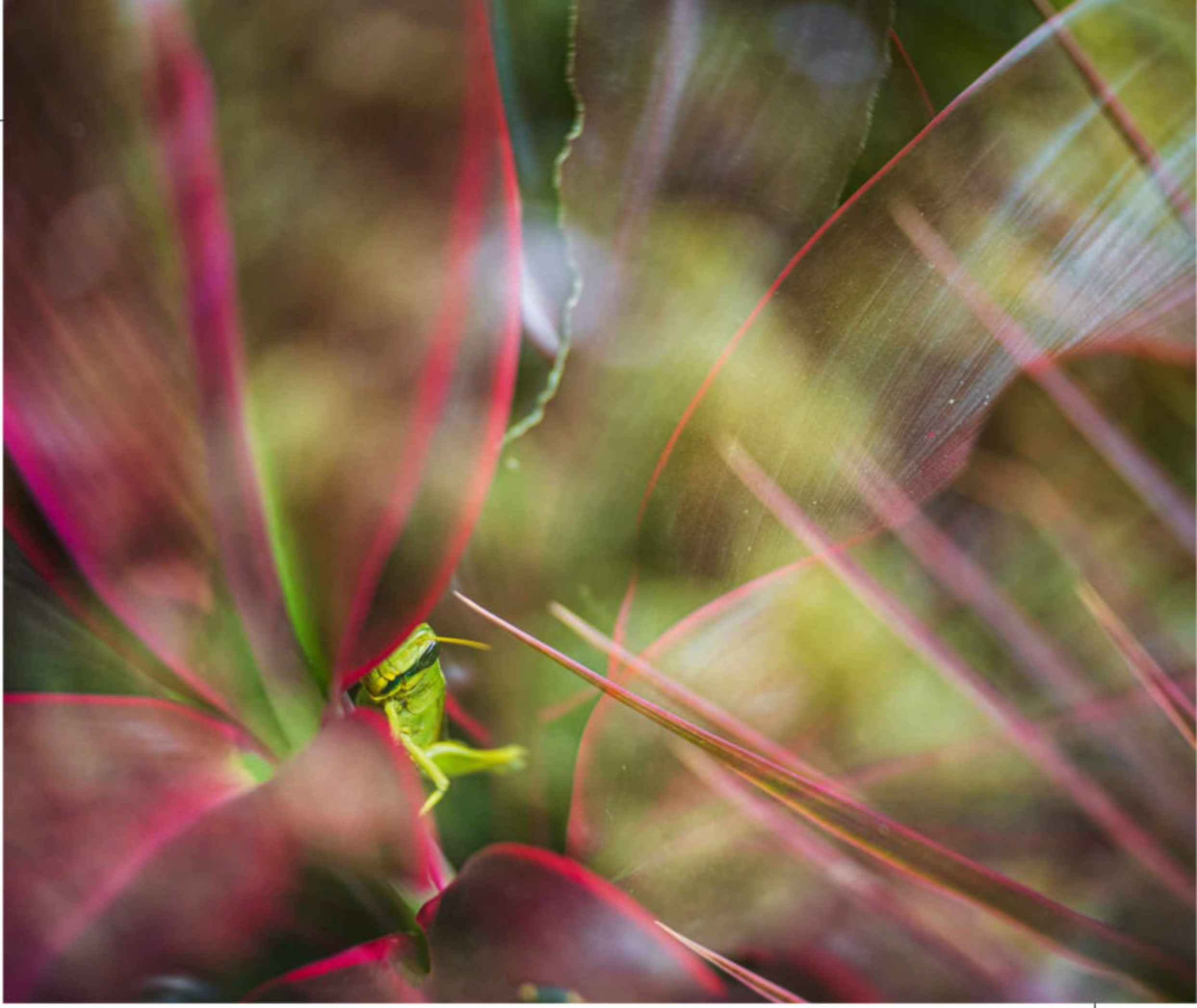
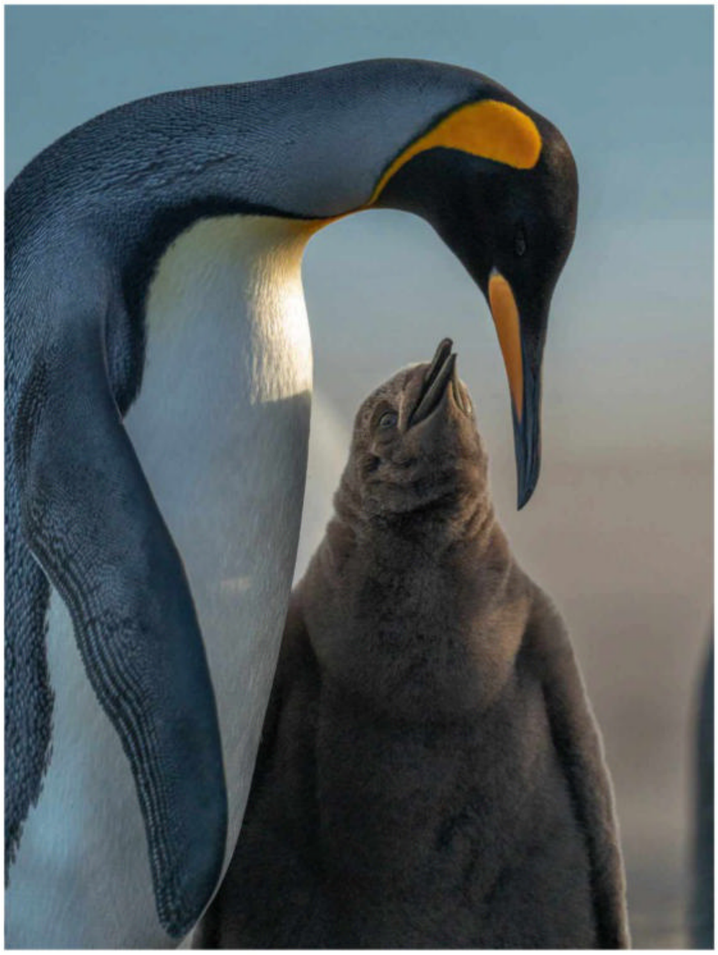


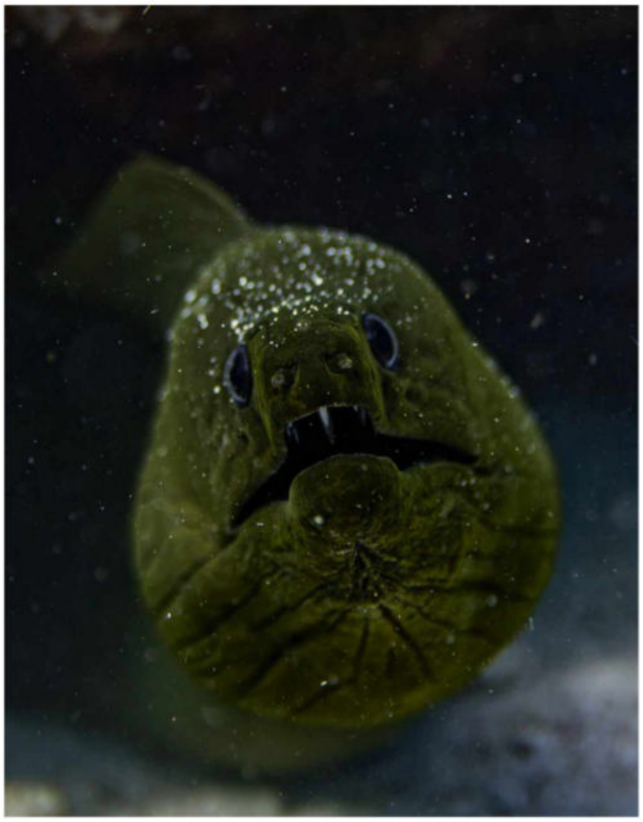
Peeping beauty

Renowned jumpers, short-horned grasshoppers are found around the globe, in diverse colours and sizes.
Saurabh Chakraborty, Kolkata, India

Eat like a king

A king penguin youngster requires a constant stream of fish to eat. Unfortunately for the parents, this colony on the Falkland Islands is some distance from the sea.
Bob Brewer, Chichester, UK





Curious moray

The experience of being face-to-face with a moray eel, off Key Largo in Florida, USA, is a memory I hope to always cherish.
Nicholas Conzone, Silver Springs, Florida

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Celebrity APEX

Sebastian on location in the Sahara desert

SNAP-CHAT

THE INSIDE WORLD OF WILDLIFE PHOTOGRAPHY

Hair-raising adventures with big-cat lover Sebastian Kennerknecht

How did your career start?

Wildlife has always been my passion. My first photo project was in my mid-20s, on 11 endangered species in northern California, from tiger salamanders to sea otters, and culminated in an exhibition at the Santa Cruz Museum of Natural History in 2011. When it dawned on me how powerful photography can be for conservation, I decided to make it my career.

Which of your images is the most important to you, and why?

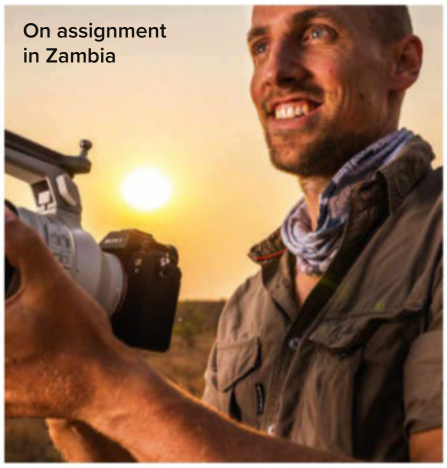
My shot of a wild Borneo bay cat from 2014. It's probably the least studied wild cat in the world – we barely know anything about its ecology. My image was published all over the world and drew lots of funding. It is something I am still proud of.

What is your most memorable shoot?

Photographing snow leopards in Kyrgyzstan was incredible. Getting to base camp required a four-hour horse ride. I slept in a tent for five weeks at sub-zero temperatures. Every day I would hike 6-12km to put up and check SLR camera traps and search for this elusive cat. It was difficult work but, when I saw my first snow leopard, I took a few frames and just started crying.

What's been your most memorable experience with wildlife?

When I was about 19 or 20, barely knowing how to find or photograph animals, I stumbled across a female bobcat with a kitten. Somehow, despite my naivety, she accepted me. She would hunt right next to me and sleep just a few metres away. I don't know what I did to deserve her trust but it's a memory that I cherish.



On assignment in Zambia

Any particularly close calls?

The scariest was a forest elephant in the jungles of Uganda. I was setting up a camera trap with a biologist when we heard a trumpet. A bull was charging, flattening every tree in its path. We ran, getting tangled in every vine and sapling. The elephant gained on us quickly. Ten metres, five metres, two metres. Without discussion, the biologist and I went different ways. The elephant stopped, returned to the camera trap and destroyed parts of it. We were alive, and that was what mattered, but I had another four weeks in the forest and was terrified the entire time.

Any epic fails?

Too many to count. I was recently shooting from a hide in Botswana. On the last day, some lions showed up at sunset. The light was beautiful. I was ecstatic. Later that day I was prepping my gear for some night photography and I accidentally formatted the SD card with all the lion shots. I can laugh about it now but it still hurts.

Which species is top of your bucket list?

Sand cats in Morocco – which is what I'm photographing currently. There are lots of challenges, including landmines, which makes the situation a bit hairy. I haven't seen a cat yet but my hopes are high.

What's the worst discomfort you've had to endure in the name of photography?

I've had hookworms tunnelling through my foot in Borneo, appendicitis in Thailand, scorpion and centipede stings, mites under the skin and hundreds of ticks and leeches attached to me. Oh, and heatstroke in India and altitude sickness in the Andes.

What has been your favourite species to turn your focus on?

Photographing pumas is incredibly special. Being on foot with a predator that could easily kill you, yet ignores your presence, is dumbfounding. We often think of wild cats as solitary but spending hundreds of hours with pumas has revealed their social dynamics are far more complicated. For example, I once watched a puma kitten leave its mother's side to travel with an unrelated female for hours.

Any tips for budding photographers?

Shoot what you are passionate about. Have fun and put the wildlife first. It will show in your photos.

Sebastian is a wildlife and conservation photographer. See more at pumapix.com

SAHARA: RACHEL TOBIAS; SELF-PORTRAIT: SEBASTIAN KENNERKNECHT

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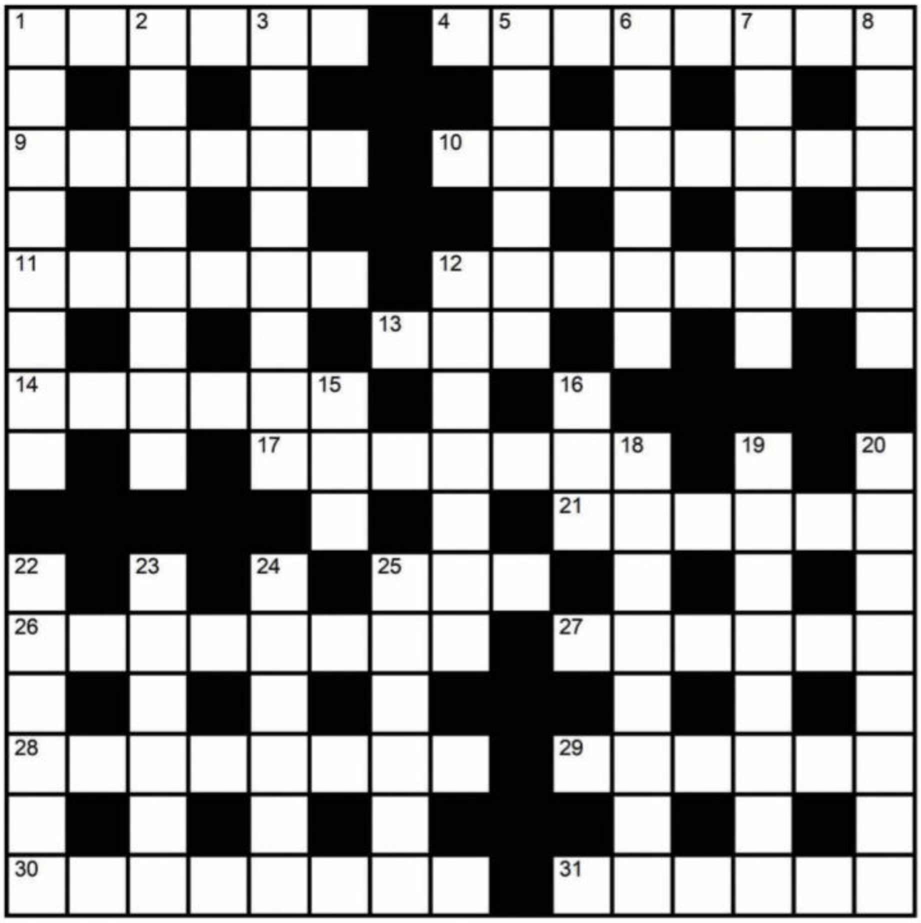
wild PUZZLES

The crossword



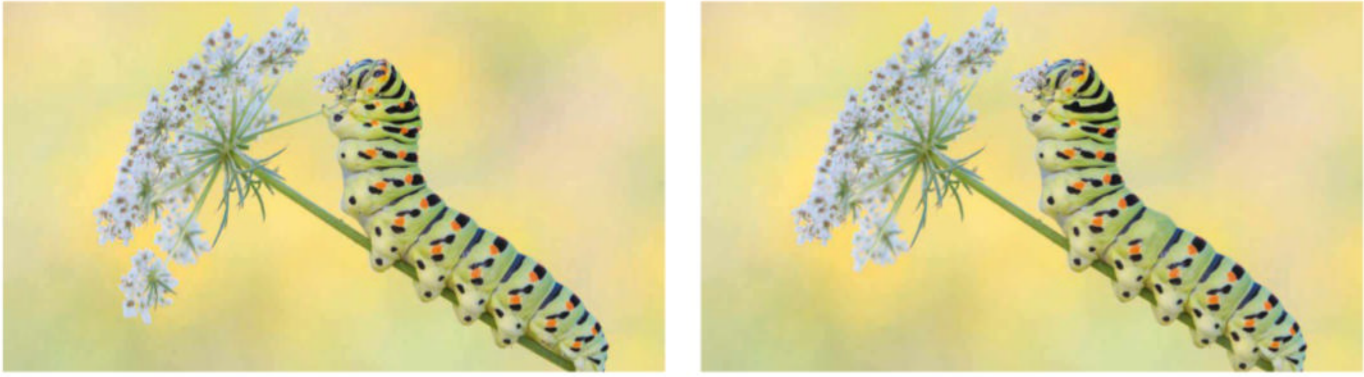
ACROSS
1 Wasp-like insect, voracious in the larval stage (6)
4 Atlantic territory, home to some 400 endemic species (2,6)
9 *Invasive* ___, book by Dan Eatherly (6)
10 Plant also known as fleabane (8)
11 ___ milk cap, fungus found near beech trees (6)
12 Vegetable derived from wild celery (8)
13 Garrulous, forest-dwelling corvid (3)
14 Dung beetle (6)
17 Songbird in the diverse family Timaliidae (7)
21 Very small seabird that may be crested or whiskered (6)
25 Zygote vessel? (3)
26 Another name for the common poppy (4,4)
27 Season when waxwings visit the UK (6)
28 Orchid also known as a fox brush (4-4)
29 Branching (6)
30 Dunnock, for example (8)
31 Reproductive part of a flower (6)

DOWN
1 Echinoderm in the class Asteroidea (8)
2 Tree of North America, *Quercus alba* (5,3)
3 Terrestrial crustacean (4,4)
5 Large game bird that may be wild or ocellated (6)
6 Young bird in the genus Aquila (6)
7 Pincered insect (6)
8 Plant in the sunflower family, sometimes called mountain tobacco (6)
12 ___ white, common Eurasian butterfly (7)
15 Flying mammal (3)
16 Carnivorous New Zealand parrot (3)
18 Mammal such as a bison or giraffe (8)
19 Simple invertebrate in the phylum Platyhelminthes (8)
20 Widespread but vulnerable fish in the family Acipenseridae (8)
22 Thorny tree also called wattle (6)
23 ___ tern, seabird noted for its long migrations (6)
24 ___ cockatoo, subspecies of New Guinea (6)
25 ___ curlew, wading bird, probably extinct (6)

Spring crossword

Across: 7 Feral, 8 Celandine, 10 Caddis, 11 Kinglets, 12 Redstart, 13 Leek, 15 Angolan, 17 Gadwall, 20 Crab, 22 Woodlice, 25 Red coral, 26 Alaska, 27 Wet meadow, 28 Coati
Down: 1 Cetaceans, 2 Pardusco, 3 Red kite, 4 Magnolia, 5 Adelie, 6 Gnats, 9 Asia, 14 Black kite, 16 Arboreal, 18 Wallaroo, 19 Swallow, 21 Raceme, 23 Opah, 24 Betel

SPOT THE DIFFERENCE



This swallowtail caterpillar is feeding on wild carrot flowers. After metamorphosis, the swallowtail is a large butterfly that has pale yellow wings with black veins. Can you spot all five differences between the two images? Turn to page 94 to find the answers.

CROSSWORD COMPILED BY RICHARD SMYTH
CATERPILLAR: EDWIN GIESBERS/NATUREPL.COM

Your LETTERS

Squirrel monkeys at London Zoo. They usually live in rainforests

The great zoo debate

EVERY YEAR OR SO *BBC WILDLIFE* HAS a pop at zoos and with the April issue that time has come around again. Once again the scions of the Born Free organisation are brought out to repeat much of the same stuff that they have said before. I believe that some zoos are good. Good for conservation, science, education and people, and able to provide a good life for the animals that live in them. The fly in the ointment is that there is a germ of truth in everything that Born Free says. I long for zoos where just a few species are kept really well in appropriate social groupings in bespoke environments and for sound reasons, whatever those reasons might be. The only zoo that ever got close to this, in my opinion, is the wonderful Jersey Zoo in the Channel Islands founded by the greatly missed Gerald Durrell.
Martin Knight, via email

While there is no doubt that a lot of improvements to animal conditions in zoos around the world are overdue, and good ones such as Bristol Zoo are making the right moves, it is clear from your article that it is always the same type of people with the same general arguments that come with critical assessments. They are anti-zoo but do not offer an alternative. They are anti-breeding of species that are threatened with extinction but their argument is to let them die out, only waking up the next day to become proponents of reintroduction. It would be a lot better if these critics actually spent serious time learning about the animal world, rather than ignoring facts because they are inconvenient to a good argument.
Jan G Roosenburg, South Carolina, USA

The Americas

The recent nature series shown on BBC One, *The Americas* (as covered in the Spring issue), featured excellent filming as expected. However… that awful narration by Tom Hanks! It reminded me of Disney's *True-Life Adventures*, the series of nature documentaries of the 1960s. They were groundbreaking at the time but the homespun all-American narration would sound heavily dated today. The TV is already full of Hollywood actors telling us which mobile phone or brand of coffee to buy. As the Americas is such a vast area, a better idea would have been to have an indigenous representative of each region narrating each episode.
Peter Lock, Bristol

Lynx reintroduction

Mark Carwardine is correct in his column concerning the reintroduction of lynx into the Cairngorms National Park (Spring issue). It is totally feasible and would be of benefit to the biodiversity of the Cairngorms and would help to control the increasing deer numbers. However, the problem is the National Farmers' Union [Scotland], as it's a powerful body that represents the farming community but also includes elite landowners who run shooting estates. By reintroducing the lynx it could impact grouse estates more than the farmers. There is the potential for farmers to lose the occasional lamb but grouse-shooting estates could be more impacted, and that is the real problem, as landowners won't want to see a reduction in their profits.
Michael White, via email

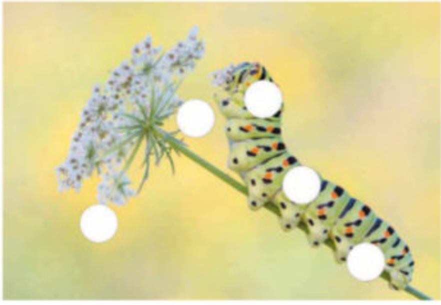
Bat fan

After a career of creating crossword puzzles, I have turned to writing sonnets on nature topics. Here is one on bats.

Essentially, they ping. They send out calls,
High-pitched, into a night that might be black.
Between each signal and its echo back,
They calculate the slight delay that falls,
Which information makes a kind of map
To tell them here's a wall, a lawn, a chair,
A birdbath and a garden path, and there
The prize, a tasty little skeeter – zap!

Their kind aren't blind, whatever old saws say.
But biosonar lets them fly by ear,
And features of the landscape come so clear
They almost seem to render sight passé.
It reels, my mind does, trying to make sense
Of senses other minds experience.

Henry Rathvon, Pennsylvania, USA


Answers to Spot The Difference on page 93

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PANGOLIN POACHING CRISIS

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Community-led patrols in pangolin hotspots are the key to stopping poaching at its source.

Pangolins are one of the most enchanting mammals in the animal kingdom.

These harmless creatures avoid confrontation at all costs, simply rolling up into a ball when predators approach, their hard scales forming an effective armour.

This survival tactic has helped keep pangolins safe since the time of the dinosaurs. But against poachers, it's useless.

It's all too easy for poachers to scoop up frightened pangolins - one after another after another - before sending them away to be served up in restaurants and turned into traditional medicines.

Since 2000, more than one million pangolins have been needlessly killed.

We need to act fast, as international demand for pangolins shows no signs of decline. Trading at the higher levels of trafficking networks is occurring on an industrial scale: from 2015 to 2021, more than 330 tonnes of pangolins and their parts were seized from traffickers in Asia alone.

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£95 could help pay for a GPS kit, allowing teams to coordinate their patrols to the most vulnerable areas.

£68 could help buy patrol boots, machetes and rucksacks to equip new rangers and help them stop poaching at its source.

£30 could help get cameras placed in trees across known pangolin hotspots.

£10 could help buy rations and subsistence for rangers on patrol for one week.

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BBC wildlife

A great white shark off the Neptune Islands near South Australia

NEXT MONTH

Back in the water

Jaws caused a global sensation on its release 50 years ago this summer. Steven Spielberg's jump-scare blockbuster emptied beaches and fuelled fear and hatred of sharks – with bloody consequences. Yet *Jaws* also inspired a generation to study these awesome apex predators. We explore the complex ecological legacy of a classic film.

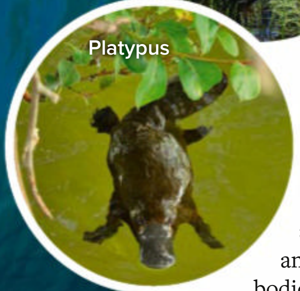
ON SALE
29th
MAY

GREAT WHITE SHARK: MIKE PARRY/MINDEN/NATUREPL.COM

Horseshoe crabs are living throwbacks to pre-dinosaur history

Tuatara

Horsetail



Platypus

Living fossils

Amazing survivors from the dawn of time

1. Coelacanth

This prehistoric-looking fish was thought to be long extinct, until a freshly killed fish showed up at a market in Eastern Cape, South Africa, in 1938. As a group, coelacanths first appeared in the Early Devonian period, around 409m years ago, and prospered until the extinction event that wiped out the dinosaurs, 66m years ago. Two surviving species live in deep-water caves and hunt at night.

2. Bristle worm

With more than 10,000 species known to science, this family of marine worms is incredibly diverse. The oldest confirmed species lived about 520m years ago. They are still found in all levels of Earth's oceans, from the surface to the abyssal plain.

3. Tuatara

It might look like a lizard but the tuatara belongs to an entirely different family of reptiles known as Rhynchocephalia. From 240 to 150m years ago, this group dominated many of the habitats occupied by lizards today, but now they're represented by just a single species – the tuatara. Today, they are confined to the uninhabited islands that surround New Zealand's North Island.

4. Okapi

This half-zebra, half-giraffe hybrid is endemic to the canopy forests of central Africa. Together with giraffes, okapis are the last living members of a once-diverse family known as Giraffidae, which dates from the Miocene period (about 20m years ago).

5. Nurse shark

At 112m years old, the nurse shark may be the oldest living vertebrate species. Most 'living fossils' are contemporary species that superficially resemble their ancient relatives, but today's nurse sharks are so similar to their ancestors that they are considered the same species.

6. Horseshoe crab

Despite the name, these aren't actually crabs. They belong to a diverse group of invertebrates known as the chelicerates, which includes spiders, scorpions and ticks. Today's horseshoe crabs look identical to those that lived during the Early Triassic period, about 250m years ago – before dinosaurs evolved. They occupy the same niches too, scuttling through silty seabeds in search of tasty invertebrates.

7. Platypus

This bizarre, egg-laying animal, which looks like a cross between a duck and a beaver, actually belongs to an ancient group of mammals known as the monotremes. This group is now represented by just the platypus and the echidna, but during the time of the dinosaurs – roughly 100m years ago – it comprised a reasonably diverse mixture of animals with strange beaks, squat bodies and paddle-shaped tails; most, like today's species, semi-aquatic.

8. Lamprey and hagfish

Nearly all vertebrates alive today have jaws, aside from lamprey and hagfish. These slender, eel-like creatures have funnel-shaped mouths lined with dozens of tiny, barb-like teeth. Lampreys originated in the Late Devonian period (circa 360m years ago), while hagfishes emerged around 50m years later in the Late Carboniferous period.

9. Snapping turtle

For the last 70m years, snapping turtles have remained virtually unchanged. This family of reptiles, known as Chelydridae, includes documented species from the time of the dinosaurs. Just like modern species, these extinct snapping turtles had long tails, ridged shells and deadly looking beaks capable of crunching through bones.

10. Horsetail

Not all 'living fossils' are animals: some types of plants have also stood the test of time. The invasive weed known as horsetail is one of those plants, emerging around 185m years ago – 55m years before the first flowering plants. The plants that once provided food for dinosaurs now grow almost anywhere, from meadows to the sides of motorways. **Will Newton**

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